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BULLETIN 468 — 490 JANUARY 1950

Corn Hybrids and Varieties In Mississippi, 1949 Tests

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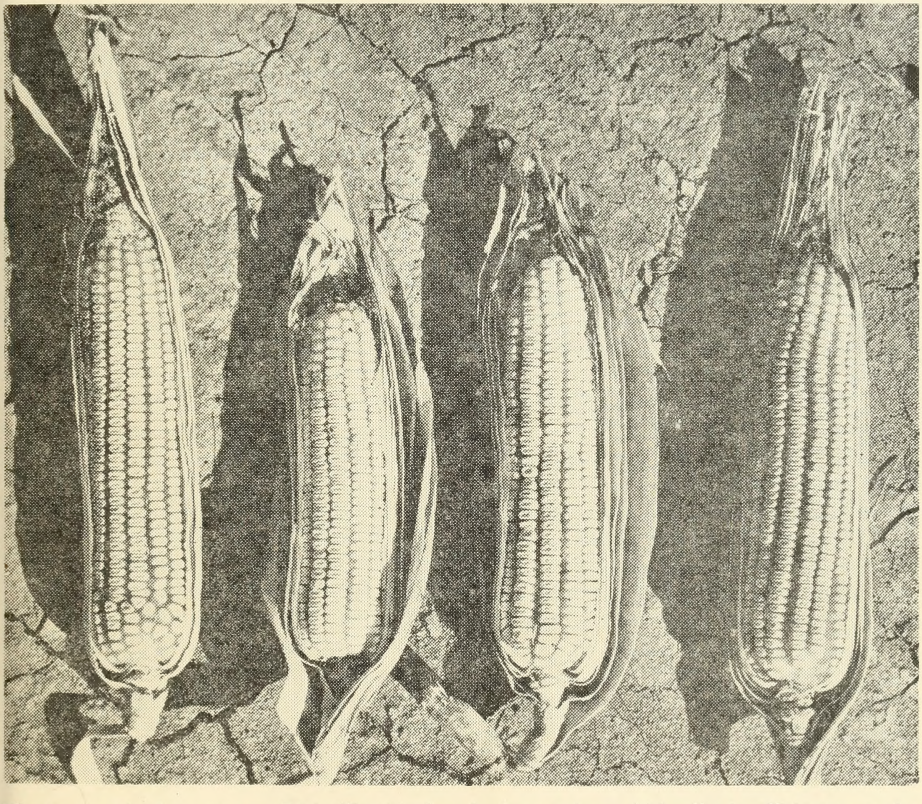

The two ears in the center are Dixie 17, with short husk extensions which offer insufficient protection against weevils in South Mississippi. The two outside ears are Dixie 18, well protected against weevils by long husk extensions. Dixie 11, a leading variety in Central Mississippi, falls between these two in husk protection.

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These corn tests are a cooperative project between the Mississippi Experiment Station and the Division of Cereal Crops and Diseases, Bureau of Plant Industry, Soils and Agricultural Engineering, and the Division of Cereal and Forage Insect Investigations, Bureau of Entomology and Plant Quarantine, Agricultural Research Administration, U. S. Department of Agriculture.

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Louie Walton, superintendent, Black Belt Branch Station, Brooksville.

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B. C. Hurt, Jr., agronomist, Coastal Plain Branch Station, Newton.

T. E. Ashley, superintendent, South Mississippi Branch Station, Poplarville.

Five plantation trials included in these tests were made possible through the cooperation of R. M. P. Short, Como; J. O. Weber, Indianola; D. L. Edson, State Penitentiary Farm, Parchman; E. T. Schaffer, Yazoo City; and H. L. Grittman, Drew.

Corn Hydrids and Varities In Mississippi

Tests designed to determine the most desirable corn strains for Missisippi farmers were conducted at State College, seven Branch Experiment Stations, and five farms in the Delta in 1949. The most promising hybrids sold in the state were compared with the best open-pollinated varieties and new hybrids.

Careful study of this year's report and that of previous years should convince the reader that when purchasing hybrid corn, it is not enough just to ask for seed of "hybrid corn." Corn hybrids have areas of adaptation the same as open-pollinated varieties. Few, if any, Corn Belt hybrids have any use as full-season corns in Southern agriculture. True, they are early maturing, but for this early maturity yield, quality and protection from insects and birds are sacrificed.

With the exception of Poplarville, each test contained 25 entries planted in a balanced lattice design with six replications. The test at Poplarville contained 16 entries in five replications. Each plot was two rows wide and ten hills long with hills and rows 40 inches apart in the greater part of the tests. Five seeds were planted per hill and later thinned to two or three per hill depending upon location. Some of the tests had fertilizer applied before planting. All tests received at least 100 pounds of nitrogen per acre.

Moisture during the growing season was not a limiting factor in the majority of the tests, however, a dry period at Holly Springs during July probably resulted in reduced yields. The stand was materially reduced by insects at Oakley. Since the first test at Newton drowned out, replanting was necessary. Much lodging occurred on all tests but was especially severe at Stoneville where a wind storm laid all entries on the ground. Due principally to unfavorable moisture conditions prior to and at planting time, the stands at Parchman and Drew were so poor that the tests were discarded.

Although rice weevil damage on farms over the greater part of the state was severe, very little damage occurred in the tests reported. Because of such light infestation, data on weevil were taken only at State College and Brooksville. Even this information is not very reliable since the plots nearest a source of infestation were damaged more than those farther removed. Observation on rice weevils in this discussion are based principally on findings of previous years.

Explanation of Tables

Yields are based on 70 pounds of ear corn per bushel. Any two kinds of corn should differ by at least the number of bushels shown opposite the notation "least significant difference" (5 percent level) before any great confidence can be placed in the two entries being really different in yielding ability.

The percentage of plants lodged are based on actual counts. All plants broken below the top ear-bearing node (joint) were classified as stalk lodged, while all plants leaning over 30 degrees or more from the vertical were classified as root-lodged.

Husk tightness is reported in grade, the larger the grade number the tighter the husk. All other notes are self-explanatory. Notes were taken on all replications harvested unless otherwise stated in the table. The yields are adjusted for plots having missing hills.

North Mississippi Results

Twenty-four of the 25 entries were planted in each of the tests in North Mississippi. The 7 station average for these entries grown at Holly Springs, Verona, Brooksville, and State College in the Hills and Como, Indianola, and Stoneville in the Delta are given in table 1.

Lodging was severe in all of these tests, with no hybrid or variety entered in all tests showing any marked degree of superiority in standing ability.

Entries not in all of the seven tests include Jarvis, Dixie 18, Miss. 8006, and Miss. 9002, the latter two being Mississippi experimental yellow hybrids.

Dixie 33, Dixie 22, Dixie 17, and Dixie 11 led in acre yield in the seven-station average. In this group of Dixie hybrids, Dixie 11 gives the best quality seed and has the most husk protection from weevils. However, since the corn in the greater part of this area is not seriously affected by the weevil, Dixie 17 is recommended over Dixie 11 on the basis of yielding ability.

Like Dixie 11, Dixie 17 is a white prolific hybrid. It has enough husk extension to keep out the birds but not

Table 1. Average, for North Mississippi, of data from hybrid tests grown at Holly Springs, Verona, Brooksville, Stoneville, Como, Indianola, and State College, 1949

Pedigree	Acre yield	Plants erect at harvest	Lodging Root	Lodging Stalk	Ears infested Rice[1] Weevil	Ear ht.	Ears per[2] plant	Stand
	bu.	pct.	pct.	pct.	pct.	ft.	no.	pct.
Dixie 33	84.8	47	27	26	31	4.2	1.4	96
Dixie 22	83.4	48	19	33	16	4.4	1.3	93
Dixie 17	83.3	37	22	41	14	4.1	1.5	97
Dixie 11	77.4	24	39	37	14	4.5	1.5	97
McCurdy 1005W	76.9	34	21	45	24	3.9	1.5	91
Miss. 9101	76.2	42	20	38	26	4.2	1.4	91
PAG 631	75.1	52	27	21	21	3.4	1.0	93
Funk G 780W	74.7	35	28	37	22	3.3	1.4	98
NC 27	74.5	41	28	31	16	4.3	1.2	95
Tenn. 602	74.3	41	13	46	21	4.3	1.1	93
Tenn. 10	73.1	39	18	43	23	3.9	1.4	94
Funk G 714	72.3	34	20	46	18	4.7	1.5	95
Hoosiercrost 707W	70.2	57	17	26	24	3.5	1.1	88
PAG 630	70.2	47	26	27	16	3.4	1.0	92
*Jellicorse	70.1	45	22	33	19	3.8	1.3	88
Miss. 7106	69.6	47	26	27	17	4.0	1.2	93
Funk G 708	69.2	41	15	44	22	3.8	1.2	91
Lowe 920	69.0	30	20	50	14	3.8	1.2	91
*Station Mosby	67.8	45	26	29	16	5.3	1.1	90
Lowe 865W	67.7	56	19	25	29	3.5	1.0	84
**DeKalb 1022	67.0	29	14	57	34	3.6	1.0	88
Funk G 720	66.3	47	26	27	18	4.8	1.1	93
DeKalb 1025	65.5	26	19	55	26	3.7	1.1	89
PAG 170	55.2	57	19	24	17	3.0	0.9	87

[1] Only Brooksville and State College.

[2] Only Holly Springs, Verona, Brooksville, Stoneville, and State College.

*Open pollinated varieties.

**Not entered in Brooksville test.

enough to offer protection from the weevil. Dixie 22 (formerly Tennessee Experimental T6013) is a high-yielding yellow hybrid with about one-fourth of the ears reddish in color. It is not as prolific as Dixie 11 and 17. A relatively small amount of seed will be on the market for 1950 planting.

Dixie 33 (formerly T7112) is a white hybrid closely related to Dixie 17 and has about the same degree of prolificy. Only a small amount of seed will be available for 1950 planting. Neither Dixie 17, Dixie 22, or Dixie 33 should be planted south of Highway 82 unless they are to be harvested early. The husk extension on any of them is not sufficient to give adequate weevil protection.

Miss. 9101 is an experimenal white hybrid. It is closely related to Dixie 17 but does not have the reddish color of Dixie 17 planting seed. There is a possibility that it will be put in production.

Several hundred bushels of Miss. 7106 were produced in 1948 and again in 1949 by the Delta Experiment Station. If production difficulties can be overcome, this white experimental hybrid may be released. It is down the list on yield but has good quality and is adapted for use with the corn picker.

McCurdy 1005W was entered in the

Table 2. Hybrid test at Holly Springs, 1949

Pedigree	Acre yield	Plants erect at harvest	Lodging		Ear ht.	Ears per[1] plant	Stand
			Root	Stalk			
	bu.	pct.	pct.	pct.	ft.	no.	pct.
Dixie 33	67.9	53	5	42	4.0	1.6	89
Dixie 22	67.6	40	0	60	4.0	1.4	92
Dixie 17	64.6	26	3	71	4.0	1.6	97
McCurdy 1005W	64.3	17	3	80	3.8	1.7	94
PAG 631	61.1	54	20	26	3.0	1.1	96
Funk G 714	58.8	24	4	72	4.3	1.7	97
Hoosiercrost 707W	58.5	59	5	36	3.5	1.1	95
Lowe 865W	58.2	59	5	36	3.8	1.1	92
Tenn. 10	57.9	18	1	81	4.0	1.6	93
Tenn. 602	57.7	24	0	76	4.0	1.2	93
DeKalb 1025	57.7	9	1	90	3.8	1.2	95
Dixie 11	57.7	5	6	89	4.0	1.6	94
PAG 630	56.3	46	6	48	3.2	1.1	96
*Jellicorse	55.0	38	5	57	3.5	1.4	91
NC 27	55.0	26	3	71	3.8	1.3	95
Lowe 920	54.5	21	2	77	3.7	1.4	91
Miss. 9101	53.6	29	2	69	4.0	1.4	91
DeKalb 1022	53.5	18	1	81	3.5	1.1	92
Funk G 780W	53.0	10	6	84	4.5	1.3	94
Funk G 708	52.9	19	1	80	3.5	1.3	94
PAG 170	50.4	57	5	38	3.2	1.0	93
Miss 7106	48.9	45	5	50	4.0	1.1	93
*Station Mosby	47.3	35	9	56	5.0	1.2	93
Funk G 720	46.9	31	3	66	4.3	1.2	94
*Jarvis (Holly Springs)	34.6	52	2	46	2.7	1.1	78

*Open pollinated varieties.

[1] Data from three replications.

A difference in yield of at least 6.9 bushels per acre is required to be considered significant.

tests for the first time and yielded well. It has a closed pedigree but closely resembles Dixie 17, although the ears are less uniform.

Three hybrids of Pfister Associated Growers were entered, namely PAG 631 and PAG 630, both white and PAG 170 which is yellow. PAG 631 yielded well in 1949 as well as in 1948. It is not as prolific as the Dixie hybrids entered in this test but has a somewhat lower ear placement. PAG 630 is mediocre and PAG 170 is too poor to recommend.

Of the Funk G hybrids tested, Funk G 780W gave the best yield. This is the first year this hybrid has been tested but, on a one-season basis, it appears that G 780W is higher yielding and more prolific than the other Funk entries. Funk G 714 ranked, in relation to all other entries, about the same as in previous years but Funk G 720 did not yield nearly so well as in 1948. In all tests but one, Funk G 708 yielded less than Funk G 714.

NC 27 and T602, both yellow, and Tenn. 10, a white, yielded well even though not near the top in the average of all tests. Hoosiercrost 707W yielded about midway of the test.

Lowe and DeKalb hybrids were low-yielding and poor in quality.

Results of the individual tests for Holly Springs, Verona, Brooksville, State College, Como, Indianola, and Stoneville are shown in tables 2, 3, 4, 5, 6, 7, and 8.

Table 3. Hybrid test at Verona, 1949

Pedigree	Acre yield	Plants erect at harvest	Lodging Root	Lodging Stalk	Ear ht.	Ears per plant	Stand
	bu.	pct.	pct.	pct.	ft.	no.	pct.
Dixie 33	87.4	68	10	22	4.7	1.4	90
Dixie 22	85.0	76	5	19	4.7	1.2	88
Dixie 17	81.6	65	9	26	4.3	1.5	88
Tenn. 602	74.4	62	4	34	4.8	1.1	90
Dixie 11	74.3	66	20	14	5.3	1.4	95
Miss. 9101	73.8	76	8	16	4.0	1.5	82
Lowe 920	73.5	49	6	45	3.8	1.2	91
Funk G 780W	73.4	74	6	20	5.5	1.4	87
Funk G 714	73.3	56	7	37	5.2	1.5	86
Funk G 708	73.2	72	2	26	4.0	1.2	85
DeKalb 1025	72.6	49	7	44	3.7	1.0	86
PAG 631	72.2	81	4	15	3.3	1.1	86
McCurdy 1005W	72.2	65	9	26	4.2	1.5	85
Hoosiercrost 707W	71.2	81	6	13	3.3	1.1	86
Tenn. 10	70.8	65	7	28	3.7	1.3	86
NC 27	70.5	80	5	15	4.3	1.2	88
*Jellicorse	69.2	79	7	14	4.0	1.3	80
DeKalb 1022	69.0	46	5	49	3.5	1.0	85
*Station Mosby	67.7	78	10	12	5.7	1.1	86
Funk G 720	66.6	82	9	9	5.2	1.0	95
Miss. 7106	65.7	86	7	7	4.0	1.3	90
Miss. 9002	65.4	79	3	18	4.0	1.0	83
Lowe 865W	62.7	82	3	15	3.3	1.0	85
PAG 630	60.8	75	6	19	3.3	1.0	88
PAG 170	55.3	90	4	6	2.8	1.0	87

*Open pollinated varieties.

A difference in yield of at least 8.0 bushels per acre is required to be considered significant.

Table 4. Hybrid test at Brooksville, 1949

Pedigree	Acre yield	Plants erect at harvest	Lodging		Ears infested Rice Weevil	Ear ht.	Ears per plant	Husk tightness	Stand
			Root	Stalk					
	bu.	pct.	pct.	pct.	pct.	ft.	no.	grade	pct.
Dixie 17	66.1	68	25	7	3	3.8	1.3	2	127
Dixie 33	65.7	79	18	3	28	4.0	1.3	2	114
Dixie 22	64.4	69	27	4	1	4.2	1.2	2	113
McCurdy 1005W	64.3	61	28	11	13	4.0	1.4	1	115
Dixie 11	62.4	31	59	10	9	4.5	1.4	2	125
Funk G 780W	62.3	54	31	15	11	4.8	1.3	2	129
Tenn. 10	61.1	56	31	13	7	4.0	1.3	1	121
Miss. 9101	58.4	61	32	7	4	4.0	1.2	1	116
*Jellicorse	56.6	54	37	9	12	3.7	1.2	2	103
NC 27	56.0	48	49	3	6	4.0	1.1	2	110
Dixie 18	55.7	90	9	1	1	5.2	1.1	4	117
Tenn. 602	55.3	81	15	4	8	4.5	1.0	2	100
Funk G 714	54.7	72	15	13	2	4.5	1.2	2	119
PAG 631	54.4	51	47	2	10	3.3	0.9	1	108
Hoosiercrost 707W	53.1	83	14	3	12	3.5	1.0	2	100
Funk G 708	52.7	59	29	12	9	3.8	1.1	1	103
*Station Mosby	52.2	57	35	8	1	5.2	1.0	2	114
Miss. 7106	51.0	64	34	2	2	3.8	1.1	1	108
Lowe 920	50.5	40	42	18	5	3.8	1.1	2	97
Lowe 865W	50.1	67	26	7	10	3.3	1.0	1	92
Funk G 720	48.1	80	19	1	8	5.0	1.0	1	97
DeKalb 1025	47.4	44	32	24	12	3.5	1.0	0	87
PAG 630	47.3	57	38	5	1	3.2	1.0	2	100
Miss. 8006	42.8	82	18	0	0	3.7	0.9	3	100
PAG 170	33.5	82	11	7	2	3.0	0.9	0	97

*Open pollinated varieties.

A difference in yield of at least 5.1 bushels per acre is required to be considered significant.

Table 5. Hybrid test at Stoneville, 1949

Pedigree	Acre yield	Plants[1] erect at harvest	Lodging[1]		Ear ht.	Ears per[2] plant	Stand
			Root	Stalk			
	bu.	pct.	pct.	pct.	ft.	no.	pct.
Dixie 17	89.8	2	77	21	5.3	1.4	96
Dixie 22	867	5	61	34	5.2	1.2	92
Miss. 9101	85.4	4	73	23	5.5	1.4	92
NC 27	82.0	10	78	12	5.4	1.1	94
Dixie 33	81.8	2	88	10	5.1	1.2	95
Dixie 11	81.1	0	89	11	5.3	1.6	91
PAG 631	80.4	5	80	15	4.5	1.1	93
Funk G 780W	79.6	3	78	19	5.8	1.3	96
*Station Mosby	77.4	6	79	15	6.1	1.2	90
Funk G 720	75.4	5	70	25	5.7	1.2	93
Tenn. 602	74.6	10	44	46	5.4	1.0	92
Tenn. 10	74.1	11	57	32	5.3	1.3	91
PAG 630	73.1	4	77	19	4.2	1.0	89
Funk G 714	73.1	2	56	42	5.4	1.4	88
Hoosiercrost 707W	72.3	8	73	19	4.4	1.0	91
McCurdy 1005W	71.8	3	64	33	4.8	1.3	87
Lowe 865W	71.5	11	73	16	4.7	1.0	91
Funk G 708	71.0	11	52	37	5.1	1.1	89
Miss. 7106	70.2	2	82	16	4.8	1.1	95
*Jellicorse	68.3	8	59	33	5.0	1.1	89
Lowe 920	67.3	3	53	44	5.2	1.1	91
DeKalb 1022	60.2	9	47	44	4.9	1.0	91
DeKalb 1025	59.3	1	62	37	5.1	1.0	91
*Jarvis (Holly Springs)	45.8	3	53	44	3.2	0.8	80
PAG 170	43.3	9	67	24	4.0	0.8	91

*Open pollinated varieties.

[1] Data on three replications.

[2] Data on two replications.

A difference in yield of at least 8.9 bushels per acre is required to be considered significant.

Table 6. Hybrid test at Como, 1949

Pedigree	Acre yield	Plants erect at harvest	Lodging		Ear ht.[1]	Stand
			Root	Stalk		
	bu.	pct.	pct.	pct.	ft.	pct.
Dixie 33	100.5	27	43	30	3.5	100
PAG 630	98.2	36	31	33	3.0	94
Dixie 17	95.8	21	23	56	3.5	93
Dixie 11	93.6	19	47	34	4.0	101
Miss. 9101	92.0	36	14	50	4.0	95
Dixie 22	91.8	32	30	38	4.0	94
Lowe 865W	91.3	46	15	39	3.0	82
Hoosiercrost 707W	89.5	44	11	45	3.0	82
Miss. 7106	88.5	30	30	40	3.5	99
NC 27	88.2	19	39	42	4.5	99
PAG 631	88.0	47	25	28	3.0	91
Tenn. 10	86.2	26	12	62	3.0	94
Funk G 708	84.6	35	11	54	3.0	89
Tenn. 602	83.6	15	22	63	3.0	94
Funk G 780W	83.3	19	53	28	5.0	102
*Jellicorse	82.7	46	30	24	4.0	95
DeKalb 1022	82.3	27	15	58	3.0	90
McCurdy 1005W	81.6	21	18	61	3.0	89
Lowe 920	80.2	31	23	46	3.0	95
Funk G 714	79.7	31	30	39	4.0	100
*Station Mosby	78.8	41	30	29	5.0	89
PAG 170	76.4	43	36	21	2.5	85
DeKalb 1025	71.8	20	18	62	2.5	85
Funk G 720	64.1	18	51	31	4.0	98
*Jarvis (Holly Springs)	58.7	32	17	51	2.5	69

*Open pollinated varieties.

[1] Data on one replication.

A difference in yield of at least 17.5 bushels per acre is required to be considered significant.

Table 7. Hybrid test at Indianola, 1949

Pedigree	Acre yield	Plants erect at harvest	Lodging Root	Lodging Stalk	Ear ht.	Stand
	bu.	pct.	pct.	pct.	ft.	pct
Dixie 22	83.1	27	8	65	4.8	77
Dixie 33	81.1	23	13	64	4.1	84
Tenn. 602	80.1	21	6	73	4.5	85
PAG 631	75.7	35	10	55	3.2	81
PAG 630	74.7	26	17	57	3.2	76
McCurdy 1005W	73.9	10	11	79	3.6	71
Funk G 720	73.6	32	18	50	4.8	77
NC 27	73.5	28	16	55	4.1	80
Dixie 17	73.4	16	4	80	3.6	76
Funk G 714	72.0	15	9	76	4.7	74
Miss. 7106	70.1	22	13	65	3.7	65
Punk G 780W	67.9	16	16	68	4.3	78
DeKalb 1025	67.3	4	8	88	3.1	81
Lowe 920	67.2	13	9	78	3.5	78
Miss. 8006	66.6	54	3	43	4.0	80
Miss. 9101	66.5	18	7	75	3.6	63
Tenn. 10	66.0	27	10	63	3.2	80
Dixie 11	65.2	7	15	78	4.0	76
*Jellicorse	60.6	18	9	73	2.9	60
Funk G 708	60.5	19	6	75	3.5	76
Hoosiercrost 707W	59.3	36	10	54	3.2	67
Lowe 865W	57.3	44	10	46	2.9	54
DeKalb 1022	56.5	17	11	72	3.0	75
PAG 170	56.4	37	11	52	2.8	64
*Station Mosby	54.5	23	13	64	4.7	61

*Open pollinated varieties

A difference in yield of at least 11.6 bushels per acre is required to be considered significant.

Table 8. Hybrid test at State College, 1949

Pedigree	Acre yield	Plants erect at harvest	Lodging		Ears infested		Ear ht.	Ears[1] per plant	Stand
			Root	Stalk	Rice[1] Weevil	Ear-worm			
	bu.	pct.	pct.	pct.	pct.	pct.	ft.	no.	pct.
Dixie 17	112.1	59	14	27	24	91	4.3	1.7	99
Dixie 33	109.4	82	10	8	34	97	4.3	1.4	97
Dixie 11	107.6	36	38	26	19	89	4.3	1.7	98
Dixie 22	105.2	85	3	12	32	93	4.2	1.3	98
Miss. 9101	103.4	66	5	29	47	94	4.3	1.6	97
McCurdy 1005W	103.4	59	13	28	35	97	4.0	1.7	97
Funk G 780W	103.2	69	8	23	33	80	4.3	1.5	98
*Jellicorse	98.0	75	7	18	26	91	3.5	1.4	98
*Station Mosby	96.8	73	5	22	30	83	5.2	1.2	98
NC 27	96.0	73	7	20	25	85	4.0	1.3	99
Tenn. 10	95.3	73	5	22	39	100	4.0	1.5	96
Funk G 714	94.7	43	16	41	35	94	4.8	1.6	100
Tenn. 602	94.3	76	0	24	36	93	4.2	1.1	98
PAG 631	93.6	89	2	9	32	100	3.7	1.0	98
Miss. 7106	93.0	80	9	11	32	83	4.0	1.3	99
Funk G 720	89.7	79	11	10	29	90	4.7	1.1	95
Funk G 708	89.6	71	2	27	35	93	3.7	1.3	98
Lowe 920	89.6	48	8	44	22	96	3.8	1.4	97
Hoosiercrost 707W	87.3	87	1	12	35	98	3.7	1.1	96
Lowe 865W	83.1	86	1	13	48	99	3.8	1.1	95
DeKalb 1025	82.3	53	7	40	39	97	4.0	1.1	98
PAG 630	81.5	88	5	7	30	96	3.7	1.1	100
DeKalb 1022	80.7	59	3	38	34	99	3.7	1.0	96
PAG 170	71.3	80	2	18	32	100	3.0	1.0	94
*Jarvis (Holly Springs)	42.6	71	4	25	15	95	2.7	1.1	74

*Open pollinated varieties.

[1] Data on five replications.

A difference in yield of at least 5.8 bushels per acre is required to be considered significant.

Central Mississippi Results

Twenty-four of the entries for the tests at Newton, Oakley and Yazoo City were the same. The three station average is shown in Table 9.

Dixie 11, Dixie 18, Dixie 22, and Dixie 17 led all other entries in the three-station average. In years when the weevil is serious Dixie 17 and Dixie 22 will be very susceptible to injury. For this reason they are not recommended except for early harvest or hogging-off. Dixie 11 has adequate protection against normal weevil infestation. It has pure white kernels, high yielding ability, but lodges rather badly. Dixie 18 is somewhat lower yielding, is not as prolific as Dixie 11 but stands well until harvest. Both hybrids produce ears of excellent quality. Miss. 9101, McCurdy 1005W, NC 27, Miss. 7106, Funk G 780W, Funk G 708, and PAG 630 all yielded above Station Mosby. Since the 24 entries in table 9 were the same as in the North Mississippi tests, the descriptions are given in the preceding section.

In addition, a Mississippi experimental yellow hybrid, Miss. 8006, was planted at Oakley and Yazoo City. Although yielding almost nine bushels less than the top entry, it was surpassed in standability only by high-yielding Dixie 18 and Tenn. 602 and low-yielding PAG 630, PAG 631, PAG 170, and Hoosiercrost 707W. The ear placement is lower than

Table 9. Average, for Central Mississippi, of data from hybrid tests at Newton, Oakley, and Yazoo City, 1949

Pedigree	Acre yield	Plants erect at harvest	Lodging		Ear ht.	Ears per[1] plant	Stand
			Root	Stalk			
	bu.	pct.	pct.	pct.	ft.	no.	pct.
Dixie 11	71.3	47	38	15	4.2	1.6	89
Dixie 18	64.8	80	14	6	4.9	1.4	86
Dixie 22	64.7	68	16	16	4.0	1.2	92
Dixie 17	63.4	65	15	20	3.8	1.4	88
Miss. 9101	63.0	69	13	18	3.9	1.4	85
McCurdy 1005W	62.6	59	17	24	3.5	1.4	84
NC 27	60.1	71	21	8	4.0	1.2	90
Miss. 7106	59.3	63	30	7	3.6	1.2	86
Funk G 780W	57.7	60	26	14	4.6	1.4	90
Funk G 708	57.6	66	8	26	3.4	1.2	85
PAG 630	56.4	71	17	12	3.1	1.1	85
*Station Mosby	55.9	58	26	16	4.8	1.1	87
Tenn. 602	55.3	71	11	18	3.9	1.0	90
Lowe 920	54.3	57	17	26	3.6	1.2	82
Dixie 33	53.9	73	18	9	3.8	1.2	84
PAG 631	53.9	71	16	13	3.1	1.0	86
Funk G 714	53.7	53	15	32	4.4	1.4	85
Tenn. 10	53.5	66	10	24	3.2	1.3	84
Funk G 720	52.3	69	23	8	4.2	1.0	88
*Jellicorse	51.7	64	17	19	3.2	1.2	84
Lowe 865W	50.3	75	8	17	2.7	1.1	75
DeKalb 1025	50.1	44	15	41	3.3	1.0	86
Hoosiercrost 707W	49.9	72	11	17	3.0	1.2	74
PAG 170	34.3	74	8	18	2.7	1.0	73

[1] Only Newton and Oakley.

*Open pollinated varieties.

any entry out-yielding it. At Yazoo City it surpassed all entries in standability.

At Newton, another Mississippi experimental yellow hybrid, Miss. 9001, had a higher percentage of plants erect at harvest than Dixie 18 and the same as Funk G 720, but out-yielded the latter by 13 percent. It has good husk extension so should offer plenty of protection from weevils.

Individual yields of these tests are shown in Tables 10 , 11, and 12.

Table 10. Hybrid test at Newton, 1949

Pedigree	Acre yield	Plants erect at harvest	Lodging		Ear ht.	Ears per plant	Stand
			Root	Stalk			
	bu.	pct.	pct.	pct.	ft.	no.	pct.
Dixie 17	61.2	88	0	12	3.8	1.7	87
Miss. 9101	60.4	82	2	16	4.0	1.6	90
Dixie 11	59.8	75	6	19	4.5	1.8	90
Dixie 22	58.2	85	1	14	3.8	1.4	89
Dixie 18	58.0	94	2	4	4.8	1.6	78
Dixie 33	58.0	90	6	4	3.8	1.4	83
McCurdy 1005W	56.0	91	0	9	3.3	1.6	85
NC 27	55.1	90	3	7	3.8	1.3	87
Miss. 9001	55.0	96	0	4	3.7	1.3	90
Funk G 708	54.9	85	0	15	3.3	1.5	86
Funk G 780W	54.8	82	4	14	4.7	1.5	96
Miss. 7106	54.7	94	1	5	4.0	1.5	87
Funk G 714	53.7	63	2	35	4.3	1.7	94
*Station Mosby	53.6	88	5	7	4.8	1.3	90
PAG 630	52.5	82	0	18	3.2	1.2	87
Lowe 920	51.6	71	3	26	3.3	1.4	81
Tenn. 10	51.2	84	1	15	3.0	1.5	84
Tenn. 602	50.8	83	0	17	3.5	1.2	96
PAG 631	50.4	86	0	14	3.0	1.1	86
Funk G 720	48.6	96	0	4	3.8	1.2	94
DeKalb 1025	48.1	47	3	50	3.0	1.2	86
Hoosiercrost 707W	47.8	85	0	15	3.0	1.3	84
*Jellicorse	44.9	86	2	12	3.2	1.3	85
Lowe 865W	43.2	85	0	15	2.5	1.1	83
PAG 170	34.4	88	0	12	2.5	1.0	82

*Open pollinated varieties.

A difference in yield of at least 7.6 bushels per acre is required to be considered significant.

Table 11. Hybrid test at Oakley, 1949

Pedigree	Acre yield	Plants erect at harvest	Lodging		Ear ht.	Ears per plant	Stand
			Root	Stalk			
	bu.	pct.	pct.	pct.	ft.	no.	pct.
Dixie 22	50.0	77	18	5	4.2	1.0	98
NC 27	46.4	77	23	0	3.8	1.1	91
Dixie 11	46.2	38	55	7	4.0	1.4	90
Dixie 17	44.5	74	13	13	3.8	1.2	88
Miss. 9101	44.4	81	10	9	4.0	1.3	80
Dixie 18	42.3	95	4	1	4.5	1.1	92
McCurdy 1005W	41.9	61	18	21	3.7	1.3	85
Miss. 8006	41.4	84	14	2	3.5	0.9	85
Tenn. 602	40.8	89	7	4	4.2	0.9	89
Dixie 33	40.3	75	17	8	3.5	1.0	80
Funk G 708	40.2	80	14	6	3.3	0.9	83
Funk G 780W	40.1	60	33	7	4.5	1.3	90
Lowe 920	39.8	68	17	15	3.7	1.0	83
Miss. 7106	39.4	71	28	1	3.3	1.0	91
Lowe 865W	39.1	84	10	6	2.7	1.1	64
DeKalb 1025	38.9	53	29	18	3.7	0.8	87
*Jellicorse	38.0	76	18	6	3.0	1.2	78
Tenn. 10	37.3	76	14	10	3.3	1.1	84
Funk G 720	36.3	70	27	3	4.0	0.9	91
PAG 630	35.8	86	9	5	3.2	1.0	79
*Station Mosby	34.6	58	31	11	4.2	0.9	83
Funk G 714	34.3	75	10	15	4.0	1.1	80
Hoosiercrost 707W	33.0	88	6	6	3.0	1.0	66
PAG 631	32.3	87	11	2	3.2	1.0	78
PAG 170	25.5	98	1	1	2.8	0.9	61

*Open pollinated varieties.

A difference in yield of at least 6.7 bushels per acre is required to be considered significant.

South Mississippi Results

Sixteen entries were planted in the test at Poplarville. Because of the extremely poor stand of Piggott Red Cob, data on this variety was not used. Yields and other information for this test are shown in table 13.

Because of only a slight infestation of weevils at Poplarville, no additional information on resistance or protection could be obtained on hybrids not in the test last year.

Dixie 11, Dixie 18, and Dixie 17 ranked first, third, and fourth, respectively, with no significant differences between them. Seed of Funk 790W was acquired from two sources. That obtained from the Louisiana Seed Company, Alexandria, La., ranked second in the test while the seed bought from another source yielded about nine bushels less. Both entries lodged badly. Dixie 18, is a yellow hybrid that stands better than any commercial in the test. It has grain of excellent quality and better husk protection against weevils than either Dixie 11 or Dixie 17. It is especially adapted to South Mississippi. Dixie 17 should not be planted except for very early harvest. Dixie 11 has more protection from weevils than Dixie 17 but less than Dixie 18. It yields high but lodges.

GCP 8001, an experimental white hybrid of the Georgia Coastal Plain Station, stood about as well and yielded almost as much as Dixie 18.

Funk G 737 from the Louisiana Seed Company yielded considerably more than

Table 12. Hybrid test at Yazoo City, 1949

Pedigree	Acre yield	Plants erect at harvest	Lodging		Ear ht.	Stand
			Root	Stalk		
	bu.	pct.	pct.	pct.	ft.	pct.
Dixie 11	108.0	29	52	19	4.2	87
Dixie 18	94.2	53	35	12	5.4	87
McCurdy 1005W	90.0	27	32	41	3.4	83
Dixie 22	85.8	42	29	29	4.0	88
Dixie 17	84.5	35	31	34	3.7	88
Miss. 8006	84.3	74	15	11	3.5	85
Miss. 9101	84.3	44	26	30	3.8	86
Miss. 7106	83.8	25	61	14	3.6	81
PAG 630	81.0	43	43	14	3.0	88
PAG 631	79.1	42	36	22	3.0	93
NC 27	78.4	46	37	17	4.3	92
Funk G 780W	78.1	37	41	22	4.7	83
Funk G 708	77.7	32	11	57	3.5	85
*Station Mosby	76.9	28	41	31	5.3	87
Tenn. 602	74.3	42	26	32	4.0	86
Funk G 714	73.2	21	33	46	4.8	81
*Jellicorse	72.3	31	31	38	3.4	88
Funk G 720	72.0	42	42	16	4.7	79
Tenn. 10	71.9	38	15	47	3.3	83
Lowe 920	71.4	31	32	37	3.8	81
Hoosiercrost 707W	68.9	43	26	31	3.1	72
Lowe 865W	68.7	56	14	30	3.0	77
Dixie 33	63.3	53	32	15	4.2	89
DeKalb 1025	63.3	32	14	54	3.2	85
PAG 170	43.0	36	22	42	2.9	75

*Open pollinated varieties.

A difference in yield of at least 23.6 bushels per acre is required to be considered significant.

Funk G 737 purchased from another source. This hybrid has a fair amount of resistance to weevils.

Yields of McCurdy 1010W were about midway in the test. Miss. 8010 did not yield or stand as well as in 1948.

Table 13. Hybrid test at Poplarville, 1949

Pedigree	Acre yield	Plants erect at harvest	Lodging		Ear ht.	Ears per plant	Stand
			Root	Stalk			
	bu.	pct.	pct.	pct.	ft.	no.	pct.
Dixie 11	73.0	38	8	54	3.4	1.5	92
Funk G 790W (La. Seed Co.)	69.3	40	2	58	3.8	1.1	92
Dixie 18 (Commercial)	66.6	61	0	39	3.6	1.1	91
Dixie 17	66.1	39	1	60	2.8	1.3	90
Dixie 18 (Hand Pollinated)	64.2	76	0	24	3.4	1.1	93
GCP 8100	62.6	72	1	27	3.8	1.2	86
Funk G 737 (La. Seed Co.)	61.3	52	0	48	3.4	1.1	94
Funk G 790W (Local Seed Store)	60.5	47	4	49	3.6	1.1	97
McCurdy 1010W	60.0	44	1	55	3.2	1.2	88
Miss. 8010	55.8	43	2	55	3.0	1.0	84
Funk G 737 (Local Seed Store)	55.6	56	3	41	3.6	0.9	92
Funk G 720	51.9	52	1	47	3.2	1.0	87
McCurdy 1002	51.6	23	2	75	3.0	1.0	84
*Station Mosby	50.8	52	2	46	3.8	1.1	82
Texas 13W	46.6	25	3	72	3.0	1.0	75

*Open pollinated varieties.

A difference in yield of at least 9.4 bushels per acre is required to be considered significant.

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1949 Cotton Variety Tests

In Hill Sections of Mississippi

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
FRANK J. WELCH, Director

STATE COLLEGE MISSISSIPPI

1949 Cotton Variety Tests

HILL SECTIONS

By J. F. O'KELLY, LOUIE WALTON, BILLY ARNOLD,
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Results of the 1949 cotton variety trials conducted by the Mississippi Experiment Station in the hill areas of the state are reported here along with average yields for longer periods.

Wide contrasts in seasonal rainfall cause cotton yields to vary widely from year to year. Rainfall in the 1949 season was so abnormally high at the hill stations that the plants did not thrive well and insect control measures were not satisfactorily effective. Under such conditions tests fail to show the potential yielding ability of varieties. Even where the differences obtained appear to have meaning, it may be due to a differential in tolerance to excessive soil moisture and they might be reversed in a widely different season. This makes it urgent that attention be centered mainly on **average** results where such are available.

The averages at State College and Holly Springs show that there are three or more varieties which do not differ greatly in yield or value. This means that, over a period of years, a farmer could grow any one of these with assurance of satisfactory performance.

The averages at the other locations are more variable. However, they cover only two years. Four or five years are usually required to reduce the weather and other variables enough for results to be dependable.

The test at Holly Springs was planted May 11. Five hundred pounds 6-8-4 fertilizer were applied before planting. Weevil infestation at that station was the most severe in several years. Dusting for insect control was only partially successful. Very little cotton was produced after the early part of August.

At State College the test was fertilized with 500 pounds 5-10-5 before planting. The test was planted in late April but excessive rains made planting necessary again on May 10. Dusting for insect control was started a little too late and frequent rains reduced the efficiency of the treatments which were given. This test is a good example of the need for starting control measures early.

The highest yields of any test were obtained at Brooksville. The test was fertilized with 300 pounds 5-10-5 before planting. It was planted during the latter half of April and survived the heavy rains of early May. Insect control was started in the first half of July and discontinued August 3. Five dustings stayed on long enough to be effective. This test is a good example of what can be done by starting insect control early especially if there is a period sufficiently dry that it may be effective.

At the Coastal Plain Station, Newton, the variety test was planted April 21 with 600 pounds of 6-8-8 per acre applied in the buster furrow and 32 pounds of nitrogen per acre from ammonium nitrate applied as a side dressing just after cotton was chopped.

Good stands were obtained from all varieties. The stalk growth and fruiting were excellent during the season, yet boll weevil infestation affected the yields badly even though six applications of poison were applied after infestation reached 25 percent or more. The first three applications of poison reduced infestation to ten percent and this was maintained until migration. After migration three applications were applied but since a shortage of poison existed, poisoning had to be discontinued. The greatest damage was then done to bolls which were near maturity after last poisoning.

Stoneville 2B, Deltapine 15, Empire, Coker Wilt, and Bobshaw were the leading varieties and should be planted in this area. Where wilt is a problem, such varieties as Coker Wilt and Empire should be selected, since they have a high degree of resistance.

At the Brown Loam Station at Oakley conditions were slightly more favorable for cotton production in 1949 than in 1948. The test received 500 pounds 5-10-

STATE COLLEGE

Average results from cotton varieties, State College, 1945-'49

	Pounds lint per acre						Averages			
	1945	1946	1947	1948	1949	Average	Acre value	Staple inches	Lint percentage	Bolls per lb. lint
Bobshaw 1	453.1	435.4	422.7	722.6	380.9	482.9	178.13	1 1/16	35.9	196
Miller	484.8	418.4	480.1	729.6	308.1	480.2	172.87	31/32	37.7	170
Empire	512.6	411.6	364.0	677.9	386.9	470.6	170.82	1 1/16	37.2	160
Deltapine 15	429.3	433.9	398.2	743.4	345.0	470.0	170.88	1 1/16	39.5	187
Delfos 9169	469.2	453.4	370.4	693.9	361.3	469.6	173.54	1 1/16	36.1	187
Hi-Bred	482.7	379.3	438.8	685.3	340.5	465.3	155.02	29/32	42.8	147
Stoneville 2B	473.8	411.6	390.0	726.7	299.7	460.4	169.92	1 1/16	36.3	183
Coker, Wilt	410.0	423.0	357.1	707.2	343.0	448.1	165.79	1 1/16	36.6	188
Delfos 651	353.7	411.9	385.5	699.8	338.9	438.0	166.21	1 3/32	34.7	209

Cotton varieties, State College, 1949

	Pounds lint per acre	Acre values seed and lint			Staple inches	Lint percentage	Bolls per lb. lint
		Middling	Strict low middling	Low middling			
CSS9	402,9	138.69	131.00	115.89	1 1/32	38.9	182
Empire	386.9	133.15	125.79	111.29	1 1/32	38.9	168
Bobshaw 1	380.9	133.44	125.82	110.97	1 1/16	36.6	205
Delfos 9169	361.3	127.00	119.77	105.14	1 3/32	37.7	198
Stoneville 2492	357.7	123.48	116.69	103.27	1 1/32	38.2	183
Coker, Staple	346.7	121.70	114.77	100.73	1 3/32	38.0	206
Deltapine 15	345.0	118.78	111.88	98.43	1 1/16	40.5	187
Coker, Wilt	343.0	119.54	112.68	99.30	1 1/16	37.7	202
Hi-Bred	340.5	107.13	102.88	93.17	7/8	42.9	148
Delfos 651	338.9	124.17	115.36	99.94	1 1/8	36.0	211
Miller	308.1	104.12	98.42	87.95	31/32	38.7	181
Stoneville 2B	299.7	104.65	98.65	86.96	1 1/16	37.3	199

5 fertilizer before planting. Planting was done in the latter half of April. Dusting for insect control consisted of five treatments which were only partially effective.

The prices used in computing lint values were averages of ten weeks of the Memphis marketing season beginning with the last week of August. Seed was valued at $46.00 a ton. The staple lengths used were averages of lengths supplied by three commercial classers.

Producing cotton on soils so sloping that runoff water cannot be controlled will result in the loss of so much surface soil that the land will ultimately be unfit for profitable crop production. This practice is probably a greater menace to continued profitable cotton production than any competition yet offered by synthetics. Enforced or other cotton acreage reductions should, therefore, be made, where possible, on the more erosive soils.

HOLLY SPRINGS

Average results, cotton varieties, Holly Springs, 1945-'49

	Pounds lint per acre						Averages			
	1945	1946	1947	1948	1949	Average	Acre value	Staple inches	Lint percentage	Bolls per lb. lint
Hi-Bred	728.7	409.8	667.5	745.9	528.2	616.0	204.37	29/32	41.8	154
Empire	688.9	444.8	620.0	707.9	564.6	605.2	218.23	1 1/16	37.4	167
Miller	704.7	384.2	672.8	741.7	497.8	600.2	212.01	31/32	37.7	178
Deltapine 15	715.7	421.4	607.7	689.7	551.1	597.1	212.24	1 1/16	39.9	194
Delfos 9169	628.6	395.5	639.2	731.9	562.8	591.6	218.83	1 3/32	36.4	185
Coker, Wilt	679.2	432.2	622.8	703.1	513.8	590.2	215.42	1 1/16	36.7	194
Stoneville 2B	617.3	414.6	664.9	755.6	456.7	581.8	214.40	1 1/16	36.3	178
Delfos 651	648.7	353.0	639.8	675.1	496.3	562.7	208.18	1 3/32	35.3	208
Bobshaw 1	606.6	375.4	624.2	657.3	447.4	542.2	197.94	1 1/16	36.0	203

Cotton varieties, Holly Springs, 1949

	Pounds lint per acre	Acre value seed and lint			Staple inches	Lint percentage	Bolls per lb. lint
		Middling	Strict low middling	Low middling			
Empire	564.6	195.37	184.08	162.06	1 1/16	39.3	158
Delfos 9169	562.8	195.96	184.70	162.75	1 1/16	37.9	184
Deltapine 15	551.1	187.17	176.70	156.04	1 1/32	42.1	182
Coker, Staple	546.7	191.91	180.98	158.84	1 3/32	38.0	203
Hi-Bred	528.2	169.25	161.86	145.22	29/32	44.3	144
Coker, Wilt	513.8	178.73	168.46	148.42	1 1/16	38.1	191
Miller	497.8	167.48	158.27	141.35	31/32	39.7	172
Delfos 651	496.3	175.45	165.52	145.42	1 3/32	36.5	202
CSS9	470.4	161.38	152.45	134.81	1 1/32	39.6	181
Super Sam	463.9	169.32	157.26	136.15	1 1/8	36.8	196
Stoneville 2492	459.2	159.60	150.42	132.51	1 1/16	38.3	172
Stoneville 2B	456.7	159.39	150.25	132.44	1 1/16	37.4	176
Bobshaw 1	447.4	155.85	146.90	129.45	1 1/16	37.8	199

BROOKSVILLE

Average results from cotton varieties, Brooksville, 1948-'49

	Pounds lint per acre			Averages			
	1948	1949	Average	Acre value	Staple inches	Lint percentage	Bolls per lb. lint
Deltapine 15	229.9	669.9	449.9	157.39	1 1/16	40.3	200
Deltapine 14	210.7	655.2	432.9	153.09	1 1/16	38.9	218
Empire	196.8	654.7	425.7	151.99	1 1/16	37.3	175
Hi-Bred	221.7	620.3	421.0	139.96	29/32	41.7	166
Stoneville 2B	178.0	653.9	415.9	148.97	1 1/16	36.3	193
Delfos 9169	181.7	640.8	411.2	147.73	1 3/32	36.0	211
Coker, Wilt	173.1	614.1	393.6	140.14	1 1/16	36.6	214
Delfos 651	179.8	592.8	386.3	139.39	1 3/32	35.4	225
Coker, Staple	212.1	548.2	380.1	139.86	1 3/32	36.5	214
Miller	195.1	549.1	372.1	130.15	1	38.1	187
Bobshaw 1	176.2	529.7	352.9	126.52	1 1/16	36.1	211

Cotton varieties, Brooksville, 1949

	Pounds lint per acre	Acre values seed and lint			Staple inches	Lint percentage	Bolls per lb. lint
		Middling	Strict low middling	Low middling			
Deltapine 15	669.9	227.78	215.05	189.93	1 1/32	41.8	202
Deltapine 14	655.2	225.67	212.57	187.01	1 1/16	40.4	222
Empire	654.7	226.63	213.54	188.01	1 1/16	39.2	172
Stoneville 2B	653.9	227.58	214.50	189.00	1 1/16	38.0	198
Delfos 9169	640.8	223.53	210.71	185.72	1 1/16	37.5	212
Stoneville 2492	630.4	217.52	205.55	181.91	1 1/32	38.3	196
Hi-Bred	620.3	204.46	193.60	172.82	15/16	42.9	164
Coker, Wilt	614.1	211.99	200.32	177.31	1 1/32	38.2	227
Delfos 651	592.8	207.17	195.32	172.20	1 1/16	37.1	213
CSS9	580.1	199.80	188.78	167.03	1 1/32	38.7	196
Miller	549.1	185.95	175.79	156.57	1	39.9	181
Coker, Staple	548.2	192.34	181.38	159.17	1 3/32	38.1	225
Bobshaw 1	529.7	183.28	173.21	153.35	1 1/32	37.7	217

NEWTON

Average results from cotton varieties, Newton, 1948-1949

	Pounds lint per acre			Averages 1948-'49			
	1948	1949	Average	Acre value	Staple inches	Lint percentage	Bolls per lb. lint
Hi-Bred	515.4	273.6	394.5	125.54	7/8	43.6	165
Deltapine 15	459.7	308.2	383.9	135.84	1 1/32	42.1	204
Stoneville 2B	498.8	267.3	383.0	139.68	1 1/32	38.3	192
Coker Wilt	489.8	258.0	373.9	135.53	1 1/32	37.8	218
Empire	459.4	283.2	371.3	133.40	1 1/32	39.3	180
Bobshaw 1	471.9	245.1	358.5	131.62	1 1/32	37.0	212
Deltapine 14	474.7	241.0	357.8	127.60	1 1/32	41.2	217
Miller	501.6	191.4	346.5	124.63	31/32	39.2	190
Delfos 9169	450.8	232.7	341.7	125.99	1 1/16	38.1	204
Delfos 651	432.8	223.1	327.9	120.94	1 1/16	36.9	227
Coker Staple	450.4	180.6	315.5	116.27	1 1/16	38.2	215

NEWTON

Cotton varieties, Newton, 1949

	Pounds lint per acre	Acre value, seed and lint			Staple inches	Lint percentage	Bolls per lb. lint
		Middling	Strict low middling	Low middling			
Deltapine 15	308.2	106.51	100.34	88.32	1 1/16	39.6	214
Empire	283.2	98.97	93.31	82.26	1 1/16	37.1	185
Hi-Bred	273.6	90.75	85.96	76.79	15/16	41.3	176
Stoneville 2B	267.3	93.65	88.30	77.88	1 1/16	36.6	207
Coker, Wilt	258.0	90.99	85.83	75.77	1 1/16	35.3	248
CSS9	245.2	85.33	80.43	70.87	1 1/16	38.0	207
Bobshaw 1	245.1	86.62	81.72	72.16	1 1/16	34.9	230
Deltapine 14	241.0	83.43	78.61	69.21	1 1/16	39.2	231
Stoneville 2492	235.7	82.49	77.78	68.59	1 1/16	36.8	208
Delfos 9169	232.7	82.30	77.65	68.22	1 3/32	36.4	219
Delfos 651	223.1	79.39	74.93	65.89	1 3/32	35.2	236
Miller	191.4	64.86	61.32	54.81	31/32	38.1	205
Coker, Staple	180.6	63.40	59.78	52.74	1 1/16	36.2	233

OAKLEY

Average results from cotton varieties, Oakley, 1948-'49

	Pounds lint per acre			Averages			
	1948	1949	Average	Acre value	Staple inches	Lint percentage	Bolls per lb. lint
Deltapine 15	271.3	358.8	315.0	110.78	1 1/32	41.1	180
Empire	225.4	380.4	302.9	107.49	1 1/32	39.3	174
Miller	249.6	344.2	296.9	103.67	31/32	39.4	187
Hi-Bred	262.7	301.7	282.2	87.99	27/32	43.7	168
Coker, Staple	222.3	338.5	280.4	101.68	1 1/16	37.3	200
Deltapine 14	247.5	308.8	278.2	99.48	1 1/32	39.7	186
Delfos 651	229.7	322.4	276.0	100.39	1 1/16	36.2	208
Coker, Wilt	227.2	300.1	263.6	94.73	1 1/32	37.9	203
Stoneville 2B	240.5	286.8	263.6	95.48	1 1/32	37.5	195
Delfos 9169	230.8	257.2	244.0	89.11	1 1/16	37.1	190
Bobshaw 1	217.2	265.0	241.1	87.25	1 1/32	36.9	194

Cotton varieties, Oakley, 1949

	Pounds lint per acre	Acre value seed and lint			Staple inches	Lint percentage	Bolls per lb. lint
		Middling	Strict low middling	Low middling			
Empire	380.4	131.62	124.02	109.18	1 1/16	39.3	181
Deltapine 15	358.8	122.68	115.90	102.41	1 1/32	40.4	186
Miller	344.2	115.96	109.59	97.89	31/32	39.4	188
Coker, Staple	338.5	119.26	112.49	98.78	1 3/32	37.2	214
Delfos 651	322.4	113.12	106.67	94.09	1 1/16	36.3	207
Stoneville 2492	314.6	108.09	101.80	89.53	1 1/16	38.8	186
Deltapine 14	308.8	106.76	100.59	88.54	1 1/16	39.5	191
Hi-Bred	301.7	94.99	91.22	82.62	7/8	42.7	175
Coker, Wilt	300.1	103.79	98.12	86.84	1 1/32	37.8	199
Stoneville 2B	286.8	100.04	94.31	83.12	1 1/16	37.5	193
CSS9	274.1	94.03	88.85	78.55	1 1/32	39.6	187
Bobshaw 1	265.0	92.22	87.21	77.25	1 1/32	36.5	205
Delfos 9169	257.2	89.98	84.84	74.81	1 1/16	36.9	206

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Workstock vs. Tractors
in the
Yazoo-Mississippi Delta

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
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STATE COLLEGE MISSISSIPPI

In cooperation with the Bureau of Agricultural Economics
United States Department of Agriculture

SUMMARY AND CONCLUSIONS

1. The average cost of keeping workstock in the Delta in 1947 was $227 per animal. Mules worked an average of 78 days during the year. In many instances, costs can be reduced by providing more grazing and feeding less hay.

2. The average cost of operating medium tractors in the Delta in 1947 was $518; the average cost of operating large tractors was $736. Medium tractors were used an average of 75 days per year, and large tractors, 105 days.

3. In terms of performance rates, a medium tractor is equivalent to 6 mules and a large tractor is equivalent to at least 10 mules.

4. The data indicate that two mules are a cheaper source of power than medium or large tractors on family farms with 30 acres or less in crops, on which the family can perform nearly all the labor. On 30-acre crop units on which considerable hired labor is necessary, the medium sized tractor may be cheaper.

5. The data indicate that the medium tractor is a cheaper source of power than mules or a large tractor on units that provide as much as 18 and less than 36 days of work for the medium tractor. Such a unit would have 30 to 60 acres of crops, half of which would be planted to cotton.

6. The data indicate that the large tractor is the cheapest source of power on units with 60 acres or more in crops.

7. The medium sized tractor can replace economically at least three mules, and, if most man labor is hired, even two mules on cotton farms with 30 to 60 acres of cropland. The large tractor can replace economically at least 4 mules and in some cases as low as two. However, on large farms requiring considerable power, the most efficient rate of substitution is a medium tractor for 6 mules and a large tractor for 10 mules.

8. Many farms are carrying a surplus of power, usually as workstock. In view of the high cost of maintaining such animals, it would often be to the advantage of farmers to sell this surplus at any price.

Workstock vs. Tractors in the Yazoo-Mississippi Delta

By JAMES P. GAINES and GRADY B. CROWE[1]

Prior to 1930, horses and mules were the principal power units of the farm. Since 1930, however, the importance of work animals on farms has declined steadily. Today, only in sections beset by unfavorable economic and physical conditions do work animals supply most of the source in the operation of farms.

In the 1930's, Mississippi, and the South in general, lagged behind other areas in the United States in the mechanization of farms. Labor was so abundant and inexperienced technically that expensive mechanical power had difficulty gaining a foothold. However, the large-scale movement of farm wage hands to high-paying industrial jobs during World War II provided the spark which touched off a tremendous demand for mechanical power by Mississippi farmers. Wartime restrictions on production of tractors retarded but did not suppress the shift to mechanical power. For example, census figures show that in 1945, 65 percent more tractors were on farms in the Delta area than in 1940. The increase in tractor number in upland areas was less pronounced but was very significant during that period. Since 1945, farmers in all areas of the state have bought tractors at a rapid rate. In August, 1949, most dealers in the Delta reported that since 1945 they had sold every field tractor that could be obtained.

The widespread shift from animal to mechanical power has introduced a number of management problems. These problems are both economic and physical in nature and vary from area to area. It would be difficult to cover in one report all of the physical and economic implications in all areas of the state. This report is concerned primarily with some of the mechanization problems of operators in the Delta. The purposes are to show the average costs of maintaining workstock and of operating tractors in the Delta in 1947, and to compare work animals and tractors as sources of farm power in terms of performance rates, operating costs, reserve power, etc. It is intended to provide farmers with guides to be used in determining economic rates of substitution of mechanical for animal power, and in ascertaining the smallest sized units that can utilize tractor power and equipment more efficiently and economically than animal power and equipment. Also, it provides data for comparing medium- and large-sized tractors and determining within limits the conditions under which each is more economical.

Cost of Maintaining Workstock

In 1947, the average cost of keeping workstock used in the Delta was $227 per animal, according to data collected from operators owning a total of 143 mules and 16 horses, table 1. This cost figures includes charges for shelter and pasture, service labor, harness costs, depreciation, interest on investment, value

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[1] Agricultural economist, Mississippi Agricultural Experiment Station and agricultural economist, Bureau of Agricultural Economics, respectively.

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of feed used, and other cash costs. Feed, which constituted 76 percent of total costs, was the chief cost item, followed by service labor and depreciation.

Feed used was charged at market value, even though it may have been produced on the farm at lower cost. The use of tractors for power leaves that part of feed which ordinarily goes to workstock to be sold at market prices. Therefore, to compare tractor and workstock costs, the market value of feeds used by work animals should be charged to workstock, the more practicable procedure, or credited to tractors.

As feed comprises such a large proportion of total workstock costs, the efficiency of feeding has a major bearing on the cost of using mules and horses. In the area studied, the usual feed ration consisted of corn, oats, and hay. However, some farmers fed only corn and hay, and others fed oats and hay. Alfalfa, lespedeza, and soybean hay were the more common roughages used. On an average, 17 bushels of corn, 22 bushels of oats, and 3.8 tons of hay were fed per work animal. The high rate of hay feeding is explained by the fact that little grazing was provided. An average of only two months of grazing on improved pasture and less than one month of grazing on native pasture was provided each animal.

Table 1. Cost of keeping workstock, Delta of Mississippi, 1947

Cost items	Value
Variable costs:	**Dollars per animal[1]**
Feed:	
Corn, 17 bu.	$ 34.00
Oats, 22 bu.	23.10
Hay, 3.8 tons	114.00
Veterinary costs	1.67
Other cash costs	1.56
Service labor, 54 hrs. @ 30c	16.20
Total variable costs	$190.53
Fixed costs:	
Depreciation[2]	$ 20.62
Interest[3]	4.12
Harness (Dep. & Int.)	2.35
Shelter and pasture	9.00
Total fixed costs	$ 36.09
Total costs for year	$226.62
Total costs per 10-hour day used[4]	$ 2.91

[1] Average for 143 mules and 16 horses.

[2] Computed at 12.5% of value of 5-year old animal.

[3] Computed at 5% of average value of 5-year old animals.

[4] Average for 78 days of use.

Experiment Station studies show that feed costs can be reduced considerably by providing good pasturage to animals during the off-season and when they are idle during the work season. When workstock are idle, an improved pasture usually furnishes sufficient feed to maintain them, and concentrates need to be fed only when animals appear to be running down in condition. Experimental results indicate that when at work, animals that are on good pasture at night need about ¾ pound of concentrates and ¾ pound of hay per 100 pounds of live weight, whereas animals not on pasture require about one pound of concentrates and one pound of hay per 100 pounds of live weight. If operators who were interviewed had provided improved pasture and fed at these rates, they would have used about 30 bushels of corn and about one ton of hay per animal. Actually they were feeding concentrates near this level, but with considerably more hay and less grazing. Apparently, hay was substituted for pasture. In most instances, grazing could be provided considerably cheaper than hay.

As a general rule, then, feeding practices followed on farms were less efficient than those recommended by the Experiment Station. However, farmers strive toward the use of efficient practices. It was felt that over the long run recommended rates formed a sounder basis for computing workstock costs than did those actually followed in 1947. For this reason, these rates were used in comparing workstock and tractor costs, even though they are somewhat favorable to workstock. In addition, 1949 prices are used in order to give the data more current applicability. The estimated annual cost of keeping a mule with efficient feeding practices and 1949 prices was $142, table 2. In comparisons in later sections this figures forms the basis for computing workstock costs.

Cost of Operating Tractors

The costs of operating medium and large tractors in the Delta in 1947 are shown in table 3. [2]Medium tractors were operated at a lower average annual cost than large tractors, but they were used fewer days and did considerably less work.

For purposes of this analysis, a medium tractor is defined as one having a maximum horsepower rating of 15 to 24, while a large tractor is one having a horsepower rating 25 or more. Medium tractors are generally used with two-row equipment, and large tractors with four-row equipment. Small tractors are not used for field operations to a large extent in the area, and are not considered in this study. Later studies in other areas will give more attention to the small tractor.

Questions often asked by farmers are "How many mules **can** a tractor replace on my farm?" "How many mules **should** a tractor replace on my farm?" and "What sized tractor should I use?" These are some of the important considerations that have developed out of the transition from mule to tractor farming. There is no unqualified answer to these questions. Variations in soil types, topography, size of farm, attitude of farm operators, available workers in the operator's family, efficiency of farm workers, financial position of operators, prices and many other things have considerable influence. It would be extremely difficult to give all the many variables their due weight and ar-

Table 2. Annual cost of maintaining a mule in the Mississippi Delta with efficient feeding practices and 1949 prices

Cost items	Value
Feed:	
Corn, 30 bus. @ $1.30	$ 39.00
Hay, 1.5 tons @ $25	37.50
Pasture, 1.5 acres[1]	20.16
Veterinary costs	1.67
Other costs	1.56
Service labor, 54 hrs. @ 30c	16.20
Depreciation[2]	15.50
Interest[3]	3.10
Harness	2.35
Shelter	4.75
Total costs	$141.79

[1] Per acre costs: Fertilizer, $3.30; seed $2.49; land preparation, $.68; clipping, $1.60; fencing, $.35; and interest on land, $5.00; Pasture available 8 months per year.

[2] Computed at 12.5% of value of 5-year-old animal.

[3] Computed at 5% of one-half the average of 5-year-old animals.

Table 3. Cost of operating medium and large tractors, Delta of Mississippi, 1947

Cost items	Size of tractor	
	Medium	Large
Variable costs:	Dollars per	tractor
Fuel	$192.77	$329.02
Oil	15.17	22.75
Grease	3.87	4.02
Repairs	123.68	155.75
Service labor	12.54	24.18
Total[2]	$348.03	$535.72
Fixed costs:		
Interest[3]	$ 41.25	$ 48.75
Depreciation[4]	123.75	146.25
Housing	4.74	4.88
Total	$169.74	$199.88
Total costs for year	$517.77	$735.60
Cost per 10-hour day[5]	$ 6.87	$ 7.04

[1] Gasoline computed at 16.8 cents per gallon; fuel oil at 13 cents per gallon; oil at 15.8 cents per quart; grease at 13.4 cents per pound; and service labor at 40 cents per hour.

[2] Does not include operator labor.

[3] Computed at 5 percent of one-half of 1947 purchase price.

[4] Purchase price less 10 percent divided by average life expectancy.

[5] Medium tractors were used an average of 75.3 days, large tractors 104.7 days.

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[2] Data taken from Experiment Station Circular No. 147.

rive at a well-defined conclusion. However, it is possible to evaluate the costs and to determine within relatively narrow limits which is the more economical source of power and to indicate what influence these other factors might have. That is the objective of this section.

Performance Rates: A tractor can do much more work than a mule during the same period of time. Two mules will bed 3 to 6 acres of land per day, while a medium tractor will bed 12 to 15 acres, and a large tractor, 20 to 25 acres in a 10-hour day. Two mules will cultivate 5 to 8 acres, a medium tractor 20 to 25 acres, and a large tractor, 40 to 50 acres, in a day. The same general relationship between rates of accomplishment exists for all field operations. Thus, in terms of performance, a medium tractor is equivalent to about 6 mules and a large tractor is equivalent to at least 10 mules.

Operating Costs: Relative performance rates are an important consideration in any comparison of power unit costs. Costs per hour of operation, unless considered in the light of performance rates, do not constitute a valid basis of comparison. For example, if it cost $1.00 an hour to operate a tractor and $.50 an hour to operate a team of mules, with only cursory examination of these figures, one might be led to believe that mule power is cheaper. However, if the tractor does three times as much work as the team of mules during the hour, it can readily be seen that the tractor would provide a cheaper source of power for a given quantity of work. The total cost of power and the effect that it has on labor costs on a farm are the most important considerations and are used as a basis for comparison in this section.

Two sizes of farms were selected for comparative study of power units commonly used in the Delta. One is a 30-acre crop unit and the other, a 60-acre crop unit. These were selected because they are typical two-mule and four-mule units and as such are a good basing point around and from which to develop this discussion. For purposes of analysis, the units are assumed to be composed of ½ cotton, ⅓ corn, and ⅙ soybeans for beans. With such a crop distribution, a 30-acre unit would be composed of 15 acres of cotton, 10 acres of corn, and 5 acres of soybeans, while a 60-acre unit would have 30 acres of cotton, 20 acres of corn, and 10 acres of soybeans.

How Costs are Computed: In making the comparison of costs of operating tractors and mules on a 30-acre and a 60-acre farm shown in tables 6 and 7, the computations are based on 1949 prices. Workstock costs are about $142 per head as shown in table 2. Labor, power and equipment costs for operating the units with mule and tractor power are based on the pre-harvesting requirements of these units shown in table 4. Since harvesting methods, and consequently harvesting costs, on units of this size do not vary significantly by type of

Table 4. Pre-harvesting labor, power, and equipment requirements per acre for cotton, corn, and soybeans with three levels of mechanization, Delta of Mississippi

		Level of mechanization								
		One-row mule			Two-row tractor			Four-row tractor		
Item	Unit	Cotton	Corn	Soybeans	Cotton	Corn	Soybeans	Cotton	Corn	Soybeans
Skilled lbr.	Hrs.	----	----	----	7.7	4.8	3.8	4.6	3.3	2.5
Common lbr.	do.	57.5	13.9	15.1	35.0	----	----	35.6	.6	.6
Tractor	do.	----	----	----	7.7	4.8	3.8	4.6	3.3	2.5
Mule	do.	46.8	31.0	44.2	----	----	----	----	----	----
Tractor equip.	do.	----	----	----	7.7	4.8	3.8	4.6	3.3	2.5
Mule equip.	do.	46.8	31.0	44.2	----	----	----	----	----	----

power, there is no need to include harvesting labor, power and equipment requirements.

Tractor and machinery costs are derived from special studies conducted in the Delta, table 3. In these studies, however, costs are averages based on average tractor and machinery use. When considering small units where tractor or machine use is far below the average, certain adjustments in these costs are necessary. In this report, costs classified as variable in table 3 are reduced in corresponding proportions as days used. For example, if tractors were used a third less on the assumed units than on average crop units in the studies, then fuel and repair costs were reduced a third. On the other hand, interest is a fixed cost and was not changed. However, depreciation, another relatively fixed cost, varied with use to a certain extent. Depreciation is due to two things—obsolescence and use. Deterioration in value due to obsolescence is fixed in character and does not vary with the extent of use of a machine. However, deterioration in value from wear, or use, is related to the amount of work a machine does. A machine which is used to capacity will wear out sooner than a like one used at only half-capacity, assuming that the same care is given both. It is difficult to determine the extent to which this will be true, and even more difficult to determine the relative degree to which use and obsolescence affect total depreciation. So any method of varying annual depreciation with use must be arbitrary. In this report, depreciation is considered due half from obsolescence and half from use. The part due to use varies directly with the number of days the machine is used, while the part due to obsolescence is fixed. The cost of tractor power under this assumed situation is shown in table 5 for the 30-acre and the 60-acre units.

Medium tractor equipment is assumed to be two-row in size, while large tractor equipment is assumed to be four-row. The equipment necessary to perform field operations on the units include a disc, a middle buster, a planter, a cultivator, and a fertilizer distributor. Figures showing the average cost of operating this equipment have not been published but are available at the Delta or Main Experiment Station. Mule equipment is one-row and is charged at 3.1 cents per hour of mule work (not equipment work). This cost, too, is based on other studies.

Costs Compared on a 30-Acre Unit: On the 30-acre unit, the data show that two mules are a cheaper source of power than a medium or large tractor, if family labor is adequate to do nearly all field work required and labor is not considered as a

Table 5. Tractor costs for field operations on a 30-acre crop unit and a 60-acre crop unit, Delta of Mississippi, 1949[1]

Item	30-acre unit		60-acre unit	
	Medium tractor	Large tractor	Medium tractor	Large tractor
	Dollars per tractor			
Fuel and grease	50.83	39.95	101.66	79.90
Repairs	29.67	20.60	59.34	41.20
Service labor	2.24	1.99	4.28	3.98
Interest on investment[2]	41.25	55.00	41.25	55.00
Depreciation[3]	61.87	91.60	91.57	100.70
Housing	4.74	4.74	4.88	4.88
Total costs	190.60	213.88	302.98	285.66

[1] Assumes ½ of cropland on cotton, ⅓ in corn and 1/6 in soybeans for grain.

[2] Computed at 5 percent of one-half the 1949 purchase price.

[3] For method of calculating, see text.

cost, table 6. If it were necessary to hire as much as 15 days of man labor for field work excluding harvesting, the medium tractor could be operated more cheaply than two mules under the conditions outlined.

If family labor is considered an item of cost at prevailing wage rates, the data then show that either the medium tractor or the large tractor is cheaper than two mules. In areas in which off-farm employment of family workers is available when they are not working on the farm, time spent on the farm is an important consideration. As a general rule, however, there is little such alternative employment in the Delta.

Whether family labor is or is not considered a cost, a medium tractor apparently is a cheaper source of power than a large tractor on 30-acre crop units. This is explained by the larger fixed costs on four-row tractors and the limited amount of work provided them on such small units.

It may be concluded, then, that two mules are a cheaper source of power, on the average, for crop-units of 30 acres in which half the cropland is planted in cotton and nearly all labor is provided by the farm family. Such a unit would provide only 12 days of field work for a large tractor and 18 days of field work for a medium tractor. However, units that are a little larger apparently can be operated more cheaply with a medium tractor. A unit large enough to require 3 mules would be in this category. Thus, it might be further concluded that a medium tractor can replace as few as 3 mules on a farm large enough to require that much power, and that, under some circumstances, it can economically replace 2 mules.

The preceding analysis is applicable primarily to family farms on which a large proportion of the labor is supplied by the farm family. Farms of this size on which most labor is hired probably would find a medium or large tractor a more economical source of power than workstock for even 30-acre units.

Costs Compared on a 60-acre Unit: Data presented in table 7 indicate that either the large or medium tractor is a more economical source of power than 4 mules

Table 6. Pre-harvesting labor, power and equipment costs on 30-acre crop unit[1] when two mules, a medium or large tractor is used for power.

Costs	Two mules 1-R equip.	Med. tractor 2-R equip.	Large tractor 4-R equip.
Tractor[2]		$188.36	$211.89
Tractor machinery	-------	137.31	185.05
Mules[2]	$251.18	-------	-------
Mule machinery	38.22	-------	-------
Necessary hired labor[3]	3.00	-------	-------
Total power, equip. and hired labor costs	$292.40	$325.67	$396.94
Skilled labor (tractor drivers)[4]	-------	82.13	51.52
Common labor[5]	352.50	159.74	164.89
Pre-harvest, total power, equip. and all labor costs	$644.90	$567.54	$613.35

[1] Composed of 15 acres of cotton, 10 acres of corn, and 5 acres of soybeans for grain.

[2] Service labor included in common labor.

[3] On this unit, the average farm family would need to hire only one day of man labor (in May), under average weather conditions, when mules are used for field work.

[4] Charged at 45 cents an hour.

[5] Charged at 30 cents an hour.

on a 60-acre farm of the type assumed, even if the farm family does most of the work, and considerably more economical than 4 mules if all labor must be hired.

Furthermore a large tractor is a slightly more economical source of power than a medium tractor when all labor is hired.

On units larger than the one assumed, the four-row tractor and equipment would be even more economical than other power alternatives. Apparently, then, operators of large farms would find it advantageous from an economic standpoint to use the large power units and equipment.

Other Considerations: Although the data presented show that medium and large tractors can be used economically on relatively small units, often there are other considerations. If capital is limited, purchase of such expensive items places a serious financial burden on operators. Many small units make barely enough for family living and they cannot meet large payments on equipment each year out of their earnings. It may cost a little more to operate mules or a small tractor, but they can meet those operating costs while they may not be able to meet the smaller operating costs of larger tractors, plus a large annual payment. Therefore, the financial position of the farm operator is an important factor in a consideration of power and equipment needs of a particular farm unit.

Another factor of importance is timeliness. Tractors permit more timely performance of field operations than do work animals; large tractors permit more timeliness than medium tractors. Too, power units with high rates of performance provide more leisure for the farm family. Work is done faster and more time is available for loafing, fishing, hunting, etc. Also, when tractors are used, work is less strenuous. In many instances, these considerations may over-shadow costs.

Workstock and Tractors as Reserve Power: Most farmers keep a certain amount of power in excess of average needs to guard against losses from unusual weather conditions. In most instances the tendency is to keep more such reserve power than is actually necessary.

Table 7. Pre-harvesting labor, power, and equipment costs on 60-acre crop unit[1], when two mules, a medium or large tractor is used for power.

Costs	Two mules 1-R equip.	Med. tractor 2-R equip.	Large tractor 4-R equip.
Tractor[2]	--------	$298.70	$281.68
Tractor machinery	--------	184.12	213.18
Mules[2]	$ 502.36	--------	--------
Mule machinery	76.44	--------	--------
Necessary hired labor[3]	142.20	76.80	58.80
Total pre-harvest power, equipment and hired labor costs	$ 721.00	$559.62	$553.66
Skilled labor (tractor driver)[4]	--------	164.25	103.05
Common labor[5]	536.40	242.48	265.58
Total pre-harvest power, equipment, hired labor and family labor costs	$1,257.40	$966.35	$922.29

[1] Composed of 30 acres of cotton, 20 acres of corn, and 10 acres of soybeans for grain.

[2] Service labor included in common labor.

[3] A part of labor for cotton chopping would have to be hired, assuming an average sized family nd average weather conditions.

[4] Charged at 45 cents an hour.

[5] Charged at 30 cents an hour.

Any power in excess of that needed to insure timeliness is surplus.

In many instances, surplus power is in the form of work animals. Many farmers keep work animals after buying tractors. According to census figures, the widespread adoption of tractor power has not produced a substantial decline in the number of workstock on Mississippi farms. In fact, from 1935 to 1945, when the number of tractors on farms in the state increased from 5,000 to 21,000, mules and horses increased in number from 427,000 to 452,000. Since 1945, workstock numbers have declined significantly but not proportionately to increases in tractor numbers.

Many farmers have bought adequate mechanical power to operate their farms but have not disposed of unneeded workstock.

There are several reasons for this tendency. At first farmers were skeptical of the ability of the tractor to displace totally the use of workstock in the field. They wanted to observe the tractor perform under varied conditions before disposing of work animals. However, most doubts of that nature have been dispelled, and it is no longer a major factor contributing toward the maintenance of surplus power. Others have a sentimental attachment to their mules and prefer to keep them until they die, then they are not replaced. The major reason, however, is that the market for workstock is limited. Rather than sell at low prices, most farmers prefer to keep work animals around for odd jobs until they die. However, in view of the high cost of keeping surplus power, it often would be to their advantage to dispose of unnecessary work animals at any price.

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TENTATIVE
RECOMMENDATIONS
FOR
WEED CONTROL in COTTON

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TENTATIVE RECOMMENDATIONS FOR WEED CONTROL IN COTTON

By PAUL J. TALLEY[1]

During the last two crop seasons extensive experiments have been conducted on weed control in cotton at the Delta Branch Experiment Station. Details of these experiments and the results obtained from them will be reported later when more complete information is available. However, the general method, with its precautions and limitations, is being presented at this time in order that planters may have the advantage of this research experience in their production of cotton this season. This method is offered as a tentative recommendation, since there is the probability that it will be improved within the next few years.

Cotton has been grown successfully without any significant amount of hoeing in several different experiments during the last two seasons. The method is based on the post-emergence use of a special type of herbicidal oil.

Application of the oils can begin soon after the cotton has emerged, making possible the elimination of weeds and grasses during the very early stages of the growth of the cotton. Some small amount of hoeing may be required if certain types of perennial weeds and grasses have become established in the fields. Hoe labor required to take care of the established perennials on a relatively well-cared-for field has been found to be very small, and the peak requirement for hand labor disappears since these perennials may be controlled more or less at the convenience of the grower. Established perennials as a rule account for an almost insignificant portion of the weed and grass problem which is usually so acute in the spring on our better cotton land.

General Nature of the Method

The method consists of the controlled, lateral application of a special type of oil which acts as a contact herbicide. This usually results in the death of young grass seedlings and also kills many of the seedlings of weeds of the broadleaf type without any significant effect on the cotton. The differential contact action is made possible to a large extent by the waxy covering which tends to protect the basal portion of the cotton seedling from the laterally applied herbicidal agent. The oil is applied to each row by two specially designed post-emergence spray shoes. These shoes are attached to the tractor and spray laterally into the row in such a manner that the oil spray covers a band approximately eight inches wide. This treated band includes the drill row of the bed. Other equipment is attached to the tractor which cultivates mechanically that portion of the row which is not being treated chemically. This cultivating equipment consists of a special blade that will not disturb or throw any dirt into the zone being protected chemically.

There are several key factors in the method which is tentatively being recommended. Some of these are:

(1) The method of land preparation and planting.

(2) The physical and chemical properties of the herbicidal oils.

(3) Dosages, frequency and number of applications.

(4) Weeds and grasses controlled by the herbicidal oil.

(5) Weeds and grasses not controlled by the herbicidal oil.

(6) Hazards and precautions.

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[1] Physiologist, Delta Branch Experiment Station, Stoneville, Mississippi, and Agent, B.P.I.S. A.E., U.S.D.A. The investigations upon which this report is based have been facilitated by grants-in-aid to the Delta Branch Experiment Station from the Lion Oil Company of El Dorado, Arkansas and Standard Agricultural Chemicals, Inc. of Hoboken, New Jersey.

(7) The equipment necessary for its application and methods of using this equipment.

These points with the exception of the equipment are discussed in detail in the following paragraphs. The equipment for post-emergence weed control is being presented in another article appearing in this same issue.

Land Preparation and Planting

Certain operations prior to planting time have a direct bearing upon the handling of the crop after planting. The field, after planting, should have a slight suggestion of beds. It is immaterial whether or not this is the result of the establishment of slight beds by the sweeps attached to the tractor when planting on land which has been prepared flat, or if it is the result of knocking down high beds at the time of planting. In either case, the soil in the region of the drill row should be approximately two inches higher than in the middles between the rows. The necessity of leaving a very slight bed arises from the fact that the water should drain away from the drill row and not be permitted to run across from one middle to the next. If this occurs, new seed will be exposed or moved into position to germinate throughout the season with a resulting decrease in the completeness of weed and grass control.

Theoretically, it can be said that the ideal method of fertilizing should be to apply the fertilizer prior to planting, approximately three inches or more below the soil level in the drill row.

The easiest and safest cotton crop to handle with the herbicidal agents under consideration is one which has been truly hill dropped with approximately 16-inch intervals between hills. It is suggested that the planting plates and sprockets be selected so as to drop sufficient seed to assure three to five seedlings per hill. When this is done, the crop will not need to be chopped out or thinned, a saving in seed cost results, and satisfactory weed control can be more easily obtained. Hill dropping to a stand does away with the necessity of chopping to remove excess cotton plants. Chopping out young seedlings also exposes fresh seed for germination and delays and postpones the time when the last seedlings of the weeds and grasses will appear and be brought under control.

The top of the bed should be as flat as possible for six or seven inches on each side of the drill row. With certain types of soil the press wheel on most planters will do a satisfactory job. In other types of soil distinct ridges and depressions may be left. These should be rolled out, or erased by a light drag, at the time of planting to assure the proper soil surface for the subsequent effective application of herbicides. Since the post-emergence oils are applied in a lateral manner, they cannot effectively come in contact with the young weed and grass seedlings if they are protected from the lateral sprays by soil ridges running lengthwise with the drill row.

Properties of Herbicidal Oils

Over 200 different petroleum fractions have been tested with regard to their possible use as herbicidal oils for post-emergence weed control in cotton. At this time it is not possible to say how many slight variations in chemical composition and physical properties can occur and still leave one with a satisfactory herbicidal oil for cotton. It can be said that the petroleum fractions which have proved satisfactory are those which are commonly referred to as naphthas. Since there are great differences in the chemical composition and physical properties of different naphthas, many of them are unsatisfactory.

The most satisfactory herbicidal oils for cotton, which have been found to date, have a boiling range of approximately 300 to 400 degrees F. They are not fortified by the addition of anything that does not occur naturally in petroleum. They contain approximately 23 to 25 percent of that group of petroleum compounds which are designated as aromatic compounds. Lower percentages of aromatics have failed to give satisfactory control of weeds and grasses, while higher percentages have damaged cotton.

The herbicidal oil may safely contain as high as 18 percent naphthenes. Possibly higher concentrations could be tolerated, but the experimental evidence on this aspect is not as complete as in the case of the aromatics. However, an extremely high concentration of naphthenes increases the toxicity of the herbicide and may cause cotton to develop a very limber stem and fall over in the row. However, cotton can tolerate as high as 18 percent naphthene if the dosage per acre is carefully controlled. The content of olefines and diolefines should be low since they have an acute toxic action to cotton. The analysis of the herbicidal oil should not show over one to two percent of this class of compounds. The predominant class of chemical compounds present in the proper type of herbicidal oil for cotton consists of the saturated members of the paraffin series.

It should be mentioned that a good oil for weed control can contribute a portion of its over-all properties to the fact that it is a mixture of the proper amounts of different components which may occur naturally in petroleum, and that all of these materials have essentially the same boiling range and volatility. A petroleum fraction with the physical and chemical characteristics which have been outlined, when applied in the proper manner and at the proper amounts per acre, permits a very definite time control over the duration of action of the agent since all fractions and component parts are very volatile. No temporary or permanent residue is left to result in a chronic or prolonged action and no undesirable reactions or changes in the soil will result.

There are several different ways in which a satisfactory post-emergence oil for weed control in cotton can be produced. The simplest method consists of the proper refinery fractionation starting with certain types of crude oil, thus producing a satisfactory oil after little or no additional processing or purification. The separation of the various components present in other naphthas and their recombination or mixing in the proper proportions is a more complicated procedure but could likewise be used to produce a satisfactory cotton herbicide. A third method of production consists of the blending of naphthas with different properties in such a manner that the composite end product possesses the desirable properties and is in balance.

At the present time, the cotton plant is the only reliable indicator of what it can and cannot tolerate as a post-emergence herbicide. The general type of oil which has been described has consistently given satisfactory results with safety in all of our tests to date when applied in the proper manner. It has been found that the addition of very small amounts of such empirical compounds as pentachlorophenol and oil soluble dinitro to an otherwise good post-emergence oil is hazardous, unnecessary, and should be avoided. Fortified oils cannot be recommended at the present on the basis of our experimental results.

Dosages, Frequency of Applications

Experiments at the Delta station have shown that within five days after cotton seedlings have emerged from the soil, as much as five gallons per acre can be applied with safety. In a like manner it has been found that this same gallonage per acre can be applied with safety to the cotton plant at any subsequent stage in its development provided the applications are not closer together than every five days. Higher dosage may result in injury to the cotton plant. If as much as ten gallons per acre is applied at any one application, at least a minor amount of temporary or permanent damage to the crop can be expected. An application of less than five gallons per acre is inadequate to control the weed and grass seedlings. We are, therefore, tentatively recommending that all applications of the type of herbicidal oil described above be made at approximately five gallons per acre and that successive applications be no closer together than five days.

The number and frequency of the applications should be determined by the weeds and grasses that develop in the field. Experimental plots have been given as many as seven applications with no permanent damage to the cotton or any significant decrease in the yield. The first application usually does the most good and advantages gained by successive applications decrease rapidly. Four or five applications should be the maximum amount required during any one season and as few as three may be found to be sufficient for any one crop year. For instance, three weeks may elapse between the first and second application, when the first application is applied at the most advantageous time and is followed by two or three weeks of relatively dry weather.

Weeds and Grasses Controlled

The type of herbicidal oil described above when applied in the proper manner will give excellent control over nut or coco grass. In a like manner it will kill the seedlings and young grass plants of the crab grass type including Brachiaria. Young pigweed seedlings will be killed by a single application provided they are not over two or three inches tall at the time. Subsequently, pigweeds become more resistant to the oil and may withstand the applications until their stems have become approximately one-half inch or larger in diameter, at which time they again become susceptible to the oil. If pigweeds are not killed until their second susceptible stage, they are large enough that they have already done considerable damage to the cotton crop and the destroyed plant, when it falls on the ground, will become a hazard to later field operations. Pigweeds, therefore, should be treated before they are over two or three inches tall. In most of the better fields in the alluvial area of the Mississippi Delta which are planted to cotton, 98 percent or more of the weeds coming up in the field consist of nut grass, crab grass, Brachiaria and pigweed. This oil gives excellent control over these pests. Annual morning glory plants are likewise controlled by this agent. It usually requires two or more applications to kill them. Seedling Johnson grass, before it has developed the lateral underground runners, is likewise killed by the oil.

Weeds and Grasses not Controlled

While the herbicidal oil will give almost complete control of all seedlings of the annual grasses and many of the broadleaf seedlings arising from small seed, such as pigweed, there are certain weeds and grasses that are not controlled by the oil. These consist of three major types. One type that will not be controlled consists of the established perennial grasses such as Johnson and Bermuda. Since this oil acts as a contact herbicide with a limited duration of action, it can and does kill back young shoots of these grasses as they are emerging from the underground rhizomes or stems. However, new shoots will subsequently arise from other buds present on these underground rhizomes. Since this is the case, it is not feasible to expect to apply such a light herbicidal oil as frequently and as many times as would be required to keep these grasses under control. Such a procedure would be neither sensible nor economical.

Another group of plants, which may not be controlled, are some of the annual broadleaf plants which originate from medium or large seed or those which rapidly develop a stem structure resistant too the recommended dosages. Such weeds as the nightshades, cocklebur, teaweed, Florida pursley, milkweed, etc., will escape permanent and complete control by the applications which are being recommended for cotton. If these plants have been abundant in the fields in recent years and have been allowed to develop seed, they will reappear as crop pests until they have been eliminated by some satisfactory means.

The third group of plants which will not be controlled successfully by this oil consists of the perennial broadleaf vines such as the so-called buck vine, trumpet vine, red vine, etc. While they may be damaged to the extent of giving temporary control in the same sense as that obtained with established Johnson grass, they will be able to send up shoots after the herbicidal applications for the season have been discontinued.

It should be stated that almost the same plants are controlled by the herbicidal oils and by flame cultivation. The main advantage of the herbicidal oil over flame cultivation lies in the fact that the oil can be applied at a much earlier stage and thus dispense with the heavy and costly early season chopping and hoeing.

Hazards and Precautions

Certain points should be considered before the method is adopted and should be kept in mind while it is being employed. The preceding discussion would indicate the inadvisability of attempting to produce cotton with herbicidal oils on fields which have been allowed to become heavily infested with such plants as cocklebur, Johnson grass, and the perennial vines. It is not feasible to attempt to offset several years of inadequate and insufficient hoeing and chopping by resorting to this new method of control. Fields which have been kept reasonably clean in the past are ideal for this method and the tentative recommendations should make it possible to continue keeping these fields in a clean and satisfactory state of cultivation.

The method suggested involves the utilization of a contact herbicide which will kill the annual grasses and many of the broadleaf weeds of the annual types without damaging cotton. It should be re-emphasized that such agents as the one described above will likewise kill or damage cotton if improperly applied, if the amount applied at any one time is too great, or if the applications are too close together.

Under ideal conditions, the first application should be made not sooner than seven days after seedlings have emerged and after the annual grasses and weeds have started germinating. Under favorable conditions the cotton seedlings will emerge before the weed pests and will be at least a week old before the weed pests emerge or pass the small, extremely soft, succulent and tender stage when they are most susceptible to the oil.

Under certain weather conditions, the grower may find that he is unable to get his equipment into the field for several weeks after planting. Weed and grass seedlings may have advanced to the stage where they are tougher and less susceptible to the oil, and also where they are so numerous and bulky that a dose of oil which could safely be applied to cotton would no longer be sufficient to eliminate the weeds. A desirable safeguard against these extreme conditions has been found in the pre-emergence application of oil soluble dinitro compounds, or pentachlorophenol in oil, making possible a delay of the first post-emergence application of oil as much as three weeks with little or no reduction of the over-all seasonal control of weeds after the post-emergence applications have been started. These pre-emergence agents will decrease the number of weed seedlings that become established and will slow down and retard temporarily the development of those that are not killed by it and thus leave the weeds in a more susceptible condition to be killed by post-emergence oils for a longer period of time.

It should be mentioned that the water soluble dinitro compounds offer some assistance in this same regard. However, in most cases where it is necessary to delay the initial application of post-emergence oil, this has been brought about by extremely heavy or prolonged rains. The oil soluble pre-emergence materials have given better results than the water soluble forms under these conditions.

If adverse weather does not enter into the picture, pre-emergence treatments have been found to be of no real supplemental value during the early portion of the crop season.

If a grower desires to introduce this additional safeguard against extremely unfavorable early season weather, which may force a delay in the first application of the post-emergence oil of as much as 10 to 14 days, he should use a pre-emergence treatment consisting of the application of either: (1) one pound of oil soluble dinitro compound, or its equivalent, dissolved in five gallons of aromatic oil and applied in 8-inch bands immediately over the drill rows, or (2) five gallons of a similar oil containing 4 percent of technical pentachlorophenol applied in the same manner. The oil used as a carrier for these pre-emergence agents may be the same one employed in post-emergence work, or it may be a more aromatic oil or one with a boiling range running up to as high as 650°F.

The satisfactory use of a herbicidal oil in post-emergence work with cotton is made possible by the fact that cotton will tolerate an amount of the oil which is adequate to kill most of the seedlings of the annual weeds and grasses. The rate of application will be dependent upon the size of the jet being used, the working pressure in the spraying system and the speed of the tractor. The jet size need not fluctuate under field conditions. Mechanical wear and tear and the human factors may cause variations in the working pressure and tractor speeds. If the speed of the tractor decreases, the rate of application per acre goes up. If the pressure increases, the rate of application will go up. Under either one of these two conditions, the rate of oil application per acre may go beyond the amount tolerated by cotton. Care, therefore, should be taken by the operator in adjusting the equipment before starting and in keeping it in adjustment during the time of spraying. Cotton has a satisfactory range of tolerance to take care of minor fluctuations in the dosages of the oil described above, but major fluctuations may cause injury or even death of the cotton plant.

A cotton plant which has been damaged to a limited extent by a single application will usually recover completely with no permanent damage or loss in the yield if given a period of two or three weeks in which to recover. However, if it is resprayed before it has recovered, further damage will result from a dose which normally would not affect the plant at all. These factors show the need for careful supervision of the application of the herbicidal oil, and also indicate that the base of the cotton stems should be examined a few days after each application and prior to the next application as a check on what has been done and also to prevent minor damage from becoming chronic injury.

The success or failure of the method to a large extent depends upon the type of cultivation which is used in conjunction with the herbicidal oil. These tentative recommendations assume that at no time is the crop to be given a heavy cultivation which would throw dirt into the 8-inch band centering on the drill row. If the cotton is "dirted" prior to the first application, the bed then takes on a shape which renders it next to impossible to obtain the necessary complete coverage with the post-emergence equipment. In a like manner, if it is "dirted" at any subsequent time, additional treatments are rendered less effective. It should be emphasized that the scattering of dirt into the drill row by any mechanical means is running the risk of moving new seed into the region which has previously been controlled, and it can be assumed that a new crop of weeds and grasses will appear as soon as moisture conditions will permit them to do so.

General Schedule of Spraying

In light of the precautions and hazards which have been mentioned, it may be desirable to outline two alternative procedures for control of weeds and grasses in cotton. These schedules by their very nature would not fit any particular crop any one season but may be of supplemental value in illustrating the procedure.

A. Pre-emergence followed by post-emergence.

(1) For pre-emergence treatment of cotton use 5 gallons per acre of an oil mixture containing either 1 pound of oil soluble dinitro or 4 percent technical pentachlorophenol. This is to be applied in an 8-inch band along the drill row either by equipment attached to the rear of the planter or by a separate operation during the first four days after planting.

(2) Apply the first post-emergence oil application at the rate of 5 gallons per acre seven or more days after the cotton has emerged or later if the weeds and grass seedlings have not appeared. The first application can be postponed until the grass seedlings are an inch or so in height or until the pigweeds are an inch to an inch and a half tall. It should be remembered that early spraying is safe and that rain may interfere with later applications.

(3) Apply the second post-emergence application when needed but not until at least 5 or more days have elapsed since the previous application. This and all subsequent applications should be at 5 gallons per acre. The time for the second application will depend upon the effectiveness of the first one. If it failed to clean out all annuals, the second application should be as early as safety permits. If rain follows and new seedlings appear, they should be treated as soon as field conditions permit since small seedlings are the easiest ones to kill.

(4) All subsequent applications should be governed by the same principles as the second application. If no treatment is needed, it is pointless to apply any oil to the cotton.

(5) If perennials and a few of the broadleaf plants have escaped, they should be flat weeded before the cotton has become knee high.

B. Post-emergence without pre-emergence.

(1) If no pre-emergence treatment is employed, the timeliness of the first application becomes a critical factor and the uncertainty over the weather which might follow during the next few days makes it desirable to apply the first dose of the herbicidal oil at the earliest safe date. This application should preferably be at the rate of five gallons per acre applied seven to ten days after the seedlings have emerged. If unsettled weather conditions indicate that in all probability a prolonged rainy spell can be expected, the cotton can be sprayed at this same rate as early as the fifth day.

(2) The second and all subsequent applications of the oil should be governed by those same principles which are outlined under A above.

Either of the methods outlined under A or B do not preclude the possible use of flame cultivation as a terminal treatment. Whether or not flame cultivation would be used with either of these two schedules should be determined by the farm operator on the basis of completeness of control of annual plants which can be eliminated by the flame cultivator.

DESIGN AND USE OF EQUIPMENT

By PAUL J. TALLEY[2] and WALTER K. PORTER, Jr.[3] [4]

The post-emergence control of weeds and grass in cotton by chemical means requires that the proper chemical agent be applied in the correct manner at the optimum rate at the most advantageous time. The importance of each aspect of the control method is such that success or failure can hinge upon it.

The method of control which is being tentatively recommended in another article in this same issue requires a definite type of equipment which should be used in precise manner. This article describes this equipment and its recommended usage.

Equipment for Post-emergence Applications

The herbicide is applied by means of post-emergence spray shoes, (fig. 1) employing two shoes for each row of cotton. Each shoe, which is attached rigidly to the cultivator, has a parallel action which will permit its base to rise and fall with the slight irregularities in the field over which it slides. This is most desirable since some irregularities cannot be avoided, and it is necessary that the lateral spray pattern of the fan type nozzle remain at all times essentially the same height above and parallel to the soil surface. This makes it possible to obtain coverage in the row by spraying across the drill row without permitting the oil to come in contact with any part of the cotton plant except the basal portion of the stem well below the seed leaves. The nozzle is held in place on the shoe by a special type of fitting or jet holder which is attached to the erect stud bolt. The nozzle should be adjusted so that the spray from it is truly horizontal and is approximately three-quarters inch above the soil line. It should be directed into the drill region of the row. The jet holder should then be locked into this position by the nuts on the stud bolt. The shoe illustrated in fig. 1 shows the stud bolt attached in approximately the center of the ground skid of the shoe. It may be attached to an extension of the skid behind the last upright. Either position will permit spraying directly into the row.

The most satisfactory type of shoe, which has been developed to date, is one where the two hinged uprights, connecting the ground skid of the shoe with the beam or bar at the top, are offset at a 45° angle. This offset serves two desirable purposes. It permits more direct visibility of the spray nozzles and their patterns by the tractor operator. It also increases the clearance between the two shoes spraying into the same row in such a manner that they can be used on cotton with greater safety and continue to be used after the cotton has reached considerable size. Fig. 1 clearly illustrates this type of offset shoe. The oil reaches the nozzle on the shoes through a neoprene hose connecting with the rest of the spraying system which is attached on other parts of the tractor.

The shoes are attached to the front gang beams of the cultivator by means of of special offset standards which are shown in figure 1. These standards fit in-

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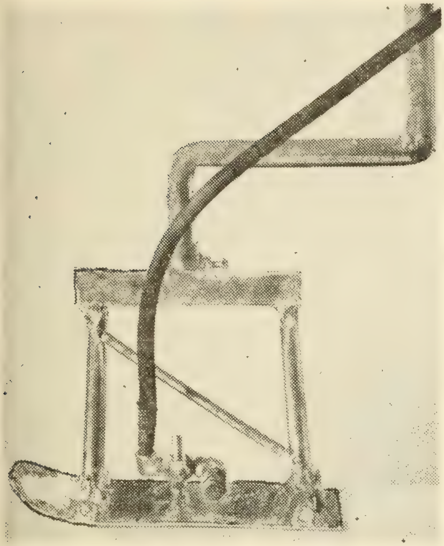

Figure I. Post-emergence spray shoe showing the type of construction which permits parallel action. The jet and supply line are shown in their functional position. The weak spring assures a light downward pressure at all times. The offset standard serves to attach the shoe to the gang beam of the tractor. A peg-type stop is attached to one of the offset uprights to prevent any tendency of the shoe to swing forward.

to the regular type clamps which are designed to hold the standards of a spring type cultivator sweep. By rotating the standards in the gang beam clamps, it is possible to move the shoes closer or further away from the drill row of the cotton. The bases of the two shoes spraying a single row should be approximately ten inches apart. The shoes should be adjusted so that the ground skids are parallel to the drill row and should then be locked in position. The spray patterns obtained from shoes adjusted in this manner will give the necessary coverage to take care of a band at least 8 inches wide in the drill row region of the bed.

Cultivation of the remaining portion of the row is accomplished at the same time the drill row is being sprayed. In practice it has been found best to have the shoe attached in a forward position on the gang beams, thus replacing what is usually considered as the inner sweeps of a standard cultivator. The tilling of the middles of the rows may be handled successfully by the use of 18-inch low crown, high-speed sweeps centered in the middles between the cotton rows. These sweeps should be set flat. Under field conditions, it is usually more satisfactory to have the middle sweeps attached at the rear of the tractor.

The cultivation of the shoulder portion, that is, the region in between that handled by the middle sweeps and the drill zone being protected by the herbicide, is one of the most critical points in the method. The weeds and grass in this region must be controlled by the tilling of the soil but at the same time dirt must not be thrown into the 8-inch band being protected chemically. In our experiments to date, we have usually accomplished this by the use of weed or beet knives. The attachment and adjustment of these weed knives is facilitated if the upright standard attaching them to the tractor is offset approximately three or four inches. This offset is necessary since the weed knives are attached on the gang beam at about the same point of attachment of the usual second set of sweeps on an ordinary cultivator. However, they must till the soil approximately one inch closer to the drill row than the inner edge of the track left by the spray shoe. The distance between the inner edges of the two weed knives cultivating the two shoulders of the same row should be approximately 8 inches. The angle or pitch of the weed knives must be adjusted to take care of variations in soil texture and moisture. The cutting edge of the weed knives should be running approximately one-half inch underneath the soil surface.

Field experiments indicate that the most unsatisfactory portion of the combined equipment for the cultivation and simultaneous application of the post-emergence oil is that portion of the cultivation accomplished by the weed knives. New, different, and better mechanical means of tillage adjacent to the region being controlled by the oils are badly needed. As yet nothing has been developed which performs this role any better than the weed knives.

The largest weed knives carried in stock by implement firms cultivate no more than a 7-inch band. The large sweep used to till the middles is made necessary in order to control the weeds and grass in the entire row without using an extra sweep or knife on each side of the row. This should be avoided if it is possible to do so. An extension can be welded onto the blade of the weed knife to increase its lateral effectiveness to approximately eight and one-half inches. It has been found that weed knives with extended blades have a distinct advantage most of the time under field conditions. However, the flexible nature of the blade of the weed knife gives less control over the depth of cultivation at the outer edge of the effective range.

The remaining portion of a spray rig for the post-emergence application of herbicides consists of a mounted tank to hold the herbicide and a pump to furnish the pressure, along with the necessary strainer, gauge, pressure regulator, cutoff valve, etc. (fig. 2). All hose used in the entire system should be of the neoprene type since it is resistant to the action of petroleum products. The tank may be made from an oil drum or may be a tank somewhat comparable in design to those used in flame cultivation or for anhydrous ammonia. It should be remembered that approximately five gallons will be used per acre for each spraying. The tank should be selected or designed for the maximum convenience with regard to farm operations. It should be as free as possible of accumulated rust and scale on the inside. The naphtha-type herbicidal agent will not cause a formation of rust but the gradual loosening of rust and scale particles in a tank may become bothersome if precautions are not taken in the initial selection of a tank. A line strainer is attached in the supply line from the tank to the pump so that any foreign particles in the system will be trapped before reaching the gear pump.

The essential features of the spraying system, with the exception of the shoes, are shown schematically in figure 2.

When herbicidal oils are being used one of the most critical parts of the spraying system is the gear pump. Several characteristics must be inherent in the structure and design of the pump. It must be able to develop and maintain a satisfactory working pressure and also be dependable and durable. The pump must be able to handle light petroleum products without leaking. In our experience to date it has been found that the most satisfactory type of pump is one that does not depend upon packing, and repacking, to prevent leakage. In other words, it is a sealed-in type of pump. It should be milled with extremely close tolerance and be of the self-lubricating type. The pump should be capable of building up and maintaining a pressure of approximately 100 pounds per square inch when the total volume of the effluent from the jets is no greater than approximately one gallon per minute. There are many pumps on the market that fail to meet these specifications and therefore cannot be used to handle oils.

The type of pump which has been described will likewise be satisfactory for emulsified insecticides. Not all pumps that are satisfactory for emulsified insecticides will handle the herbicidal oil since many of them have a graphite string-type packing. A pump with a built-in internal by-pass and pressure regulator will be satisfactory for herbicidal oils, but may not be suitable for application of the emulsified materials found in liquid insecticides. If an external by-pass is used, it should be

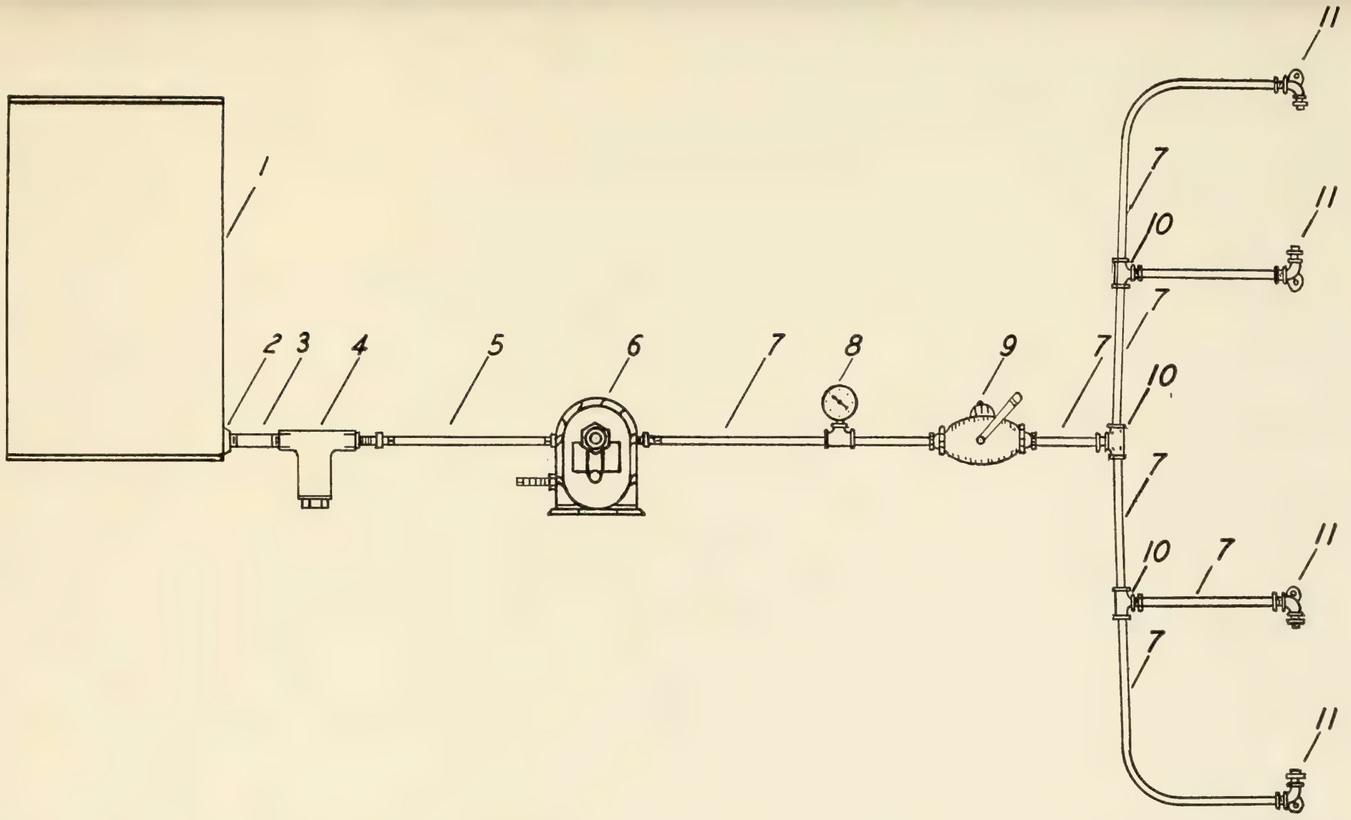

Figure 2. Schematic diagram of post-emergence spraying system showing the essential parts as required for a two-row system. (The parts are as follows: (1) tank, (2) ½" fitted outlet from tank, (3) ½" nipple, (4) line strainer, (5) ½" neoprene hose with fittings, (6) gear pump, (7) ¼" neoprene hose with fittings, (8) pressure gauge, (9) quick cutoff valve, (10) ¼" tee, (11) jet holder which is attached to shoe.

attached at a point between the pressure gauge and the cutoff as shown in the schematic diagram (fig. 2). In that case the pressure regulator would also be inserted at this same point.

The type of pump which has been described may be mounted either directly to the power take-off of the tractor or may be driven by a pulley system using a V-belt to transmit the power from the take-off of the tractor. One attached directly to the power take-off is easier to keep in adjustment and will show less wear on the bearings and the pump will last longer.

The pressure gauge should be accurate and capable of recording pressures from 0 to 100 pounds per square inch. The cutoff should be a gate-type valve which is easily and quickly manipulated. The pressure gauge and the gate valve should be arranged on the tractor so that the operating pressure will be clearly visible to the driver at all times and so that the flow of the liquid to the jets can be started and stopped by the tractor driver with ease and rapidity.

A single line from the quick cutoff valve should run to the forward part of the tractor before adding the tees and hose connections necessary to carry the herbicidal oil to the individual spray shoes. Ultimately, a separate branch of the system is attached to each spray shoe. The diagram illustrates the general system for a two-row post-emergence spray system. The necessary modifications to make it a four-row system are self-evident.

Equipment for Pre-emergence

In order to make a pre-emergence spray system out of the post-emergence spray system, illustrated in figure 2, the only changes necessary will be to substitute a proper mounting for the jets at the rear of the tractor. No modifications are necessary ahead of the quick cutoff valve. The type of pre-emergence work tentatively recommended for cotton will necessitate the centering of a fan-type jet over each row at the proper height to assure the coverage of approximately an 8-inch band by the herbicide. The hose connections and plumbing required for this arrangement can be devised with ease by the individual.

Instructions and Suggestions For Field Use

The application of the post-emergence oil under field conditions by the equipment described above will require the proper combination of tractor speed, line pressure, and jet size to give approximately the desired amount of oil. All references to gallons per acre up too this time have been based on 40-inch row widths. In practice, it is immaterial whether the rows are 36, 38, 40 or 42 inches wide. The amount applied per unit length of the row is the important factor in this regard. There will be a greater amount of oil required per acre if the rows are 38 inches instead of 40 inches wide.

Laboratory tests have shown that the rate of flow of the type of oil currently recommended varies only slightly with an increase in temperature. A change from 75° to 105° F. will increase the rate of flow, through the small size jets employed, by less than ten percent. The relative increase is about the same for all small orifice jets which have been tested. Therefore, fluctuations in temperature encountered in the field can be ignored.

Increased pressure increases the rate of flow. An increase in flow results from each rise in pressure but does not necessarily double with a doubling of pressure. The percentage increase is greater with the smaller jets. Since no general rule covering all jets is available, a table has been included which shows the proper tractor speed and type of jet to give the desired output in gallons per acre at several different pressures (table I). By consulting this table, after determining the rate of travel of the tractor at the most convenient operational speed, the proper combination of jets and working pressures can be obtained.

Several concerns are now manufacturing fan type spray jets. The jets listed in table I are some of the sizes made by Spraying Systems Co. but other makes may work equally well. In all instances noted to date the instructions for various jets show deliveries of water, or weak aqueous solutions, at various pressures. Such values have no direct bearing on the rate of flow of light oils. If other makes of jets are employed, they should be calibrated with oils to avoid the application of unknown quantities of herbicides to cotton.

The values that are given in table I assume that two jets are to be spraying into each row. In other words, they are values for the post-emergence spraying of cotton. If the farm operator wishes to use these values for the application of pre-emergence oil solutions, in which case a single jet is used over each drill row, he can do so by simply seeking the proper combination of speed, jet, and pressure to deliver ten gallons per acre instead of five gallons. When the table indicates that two jets would deliver ten gallons, a single jet would be delivering only five gallons at the same speed and pressure.

The cotton can be sprayed and cultivated by the same field operation. The cotton may not need to be sprayed over three or four times while the field may need to be cultivated several additional times in order to control the weeds and grasses in the middles and on the shoulders of the row. A satisfactory cultivation can be obtained by using the tractor with the spray shoes in position, without spraying, or the shoes may be disconnected and removed while cultivating.

After a series of rains it may be that the drill region of the row needs a spraying before the soil has dried out sufficiently to permit the use of sweeps and knives in the field. It has been found that a field can be sprayed several days earlier under these conditions if the sweeps and knives are removed. The spray shoes exert very little downward pressure and will glide over damp soil. If the tractor does not tend to stall or dig deeply into the middles, spraying without cultivation is possible. This may permit the grower to maintain a spray schedule which would be impossible otherwise.

Working drawings of the plumbing system, pump mountings, and spray shoes are available at the Delta Branch Experiment Station, Stoneville, Mississippi.

Table I: The rate of delivery in gallons per acre* of herbicidal oil for cotton by jets of different sizes with various tractor speeds and line pressures. (The recommended dosage for post-emergence work, using two jets per row, are approximately five gallons per acre. Dosages of approximately ten gallons per acre in the table will result in five gallons per acre for pre-emergence applications using only one jet per row.)

Tractor speed		Jet											
		730039		500050				650067			4001		
		Pressure (Pounds per. sq. inch)											
Miles Per Hour	Feet Per Min.	30	40	30	40	50	60	30	40	50	30	40	50
		Gallons per acre*											
2.0	176	7.4	8.9	8.2	9.4	10.8	12.0	11.7	13.2	14.9	16.2	18.3	21.1
2.2	194	6.8	8.1	7.4	8.5	9.9	10.9	10.6	12.0	13.6	14.7	16.6	19.2
2.4	211	6.2	7.4	6.8	7.8	9.0	10.0	9.7	11.0	12.4	13.5	15.2	17.6
2.6	229	5.7	6.8	6.3	7.2	8.3	9.2	9.0	10.2	11.4	12.5	14.0	16.2
2.8	246	5.3	6.4	5.8	6.7	7.7	8.6	8.3	9.4	10.7	11.6	13.0	15.0
3.0	264	5.0	5.9	5.4	6.2	7.2	8.0	7.8	8.8	9.9	10.8	12.2	14.1
3.2	282	4.6	5.6	5.1	5.8	6.8	7.5	7.3	8.3	9.3	10.1	11.4	13.2
3.4	299	4.4	5.2	4.8	5.5	6.4	7.1	6.8	7.8	8.7	9.5	10.8	12.4
3.6	317	4.1	5.0	4.5	5.2	6.0	6.7	6.5	7.3	8.3	9.0	10.2	11.7
3.8	334	3.9	4.7	4.3	4.9	5.7	6.3	6.1	7.0	7.8	8.5	9.6	11.1
4.0	352	3.7	4.5	4.1	4.7	5.4	6.0	5.8	6.6	7.4	8.1	9.1	10.5
4.2	370	3.5	4.2	3.9	4.5	5.2	5.7	5.6	6.3	7.1	7.7	8.7	10.0
4.4	387	3.4	4.0	3.7	4.2	4.9	5.5	5.3	6.0	6.8	7.4	8.3	9.6
4.6	405	3.2	3.9	3.6	4.1	4.7	5.2	5.1	5.8	6.5	7.0	7.9	9.2
4.8	422	3.1	3.7	3.4	3.9	4.5	5.0	4.9	5.5	6.2	6.7	7.6	8.8
5.0	440	3.0	3.6	3.3	3.7	4.3	4.8	4.7	5.3	6.1	6.5	7.3	8.4

***All calculations of gallons per acre assume that the rows are 40 inches wide.**

BULLETIN 472 APRIL 1950

Cultivator Spray Rig For Farm Tractor

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
FRANK J. WELCH, Director
STATE COLLEGE MISSISSIPPI

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Cultivator Spray Rig For Farm Tractor

By O. B. WOOTEN, JR.[1], W. R. SMITH[2], and WILLIAM E. MEEK[3]

With the advent of the organic insecticides new methods were necessary and machines capable of applying them were required. This was particularly true of the spray materials. Research had shown that very low quantities of highly concentrated liquids when applied by airplanes gave excellent results. The same amounts of the active ingredients, however, when applied in more dilute form with ground machines were far from satisfactory. Research was instituted to design and test ground equipment which would be equally as efficient from an insect control standpoint as the airplane had proved to be.

The application of dusting materials is restricted to those hours when there is little or no wind and when there are no convection currents which tend to cause the dusts to rise. The early morning, late afternoon and night present the best conditions for dusting. Dusting has, therefore, necessarily been a specific operation at inconvenient hours and, with ground equipment, a slow and laborious chore. In those areas where airplanes are available and where they can be used in the fields, the farmers have preferred their use due to their ability to cover large areas in a short time and because of their efficient operation. Sprays, not being as critical in relation to atmospheric conditions as are the dusts, are satisfactorily applied during most of the working hours either by airplane or by ground equipment. This one characteristic of the spray materials opened the way for the development of ground spraying equipment for both the large and the small farmer.

A cultivator spray rig has now been developed. A simple spray rig is attached to the regular tractor cultivator, and spraying for insect control is carried in in conjunction with the cultivating operation. Inasmuch as cultivation is carried on for a greater part of the growing season of the cotton crop and the spraying operation is integral with it, there is no power or labor charge for insect control. The mixing of the insecticides and the filling of the spray tank are the only additional operations necessary and require but a few minutes of the farmer's time. The cost of the insect control program is greatly reduced and the efficiency of control is usually increased. One of the hazards of any insect control program with ground operated equipment should, however, be mentioned. If unseasonal rains occur and wet fields make it impossible to operate tractors through them, then the sequence of the program may be interrupted and its efficiency impaired.

A number of spray rigs with a wide range of uses are available to the farmer. Few, however, have been designed for cotton insect control work and specifically for use with the regular cultivating equipment found on the tractors. The purpose of this bulletin is to assist those farmers who are unable to procure satisfactory spray equipment locally or who prefer to build their own machines.

A progress report of a cooperative study between the Mississippi Agricultural Experiment Station, Delta Branch, and the United States Department of Agriculture, Bureau of Plant Industry, Soils and Agricultural Engineering, Divisions of Agricultural Engineering, and the Bureau of Entomology and Plant Quarantine in which certain phases were carried on under the Research and Marketing Act of 1946.

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[2] Entomologist, U.S.D.A., Agricultural Research Administration, Bureau of Entomology and Plant Quarantine, in cooperation with the Mississippi Agricultural Experiment Station, Delta Branch, Stoneville, Mississippi.

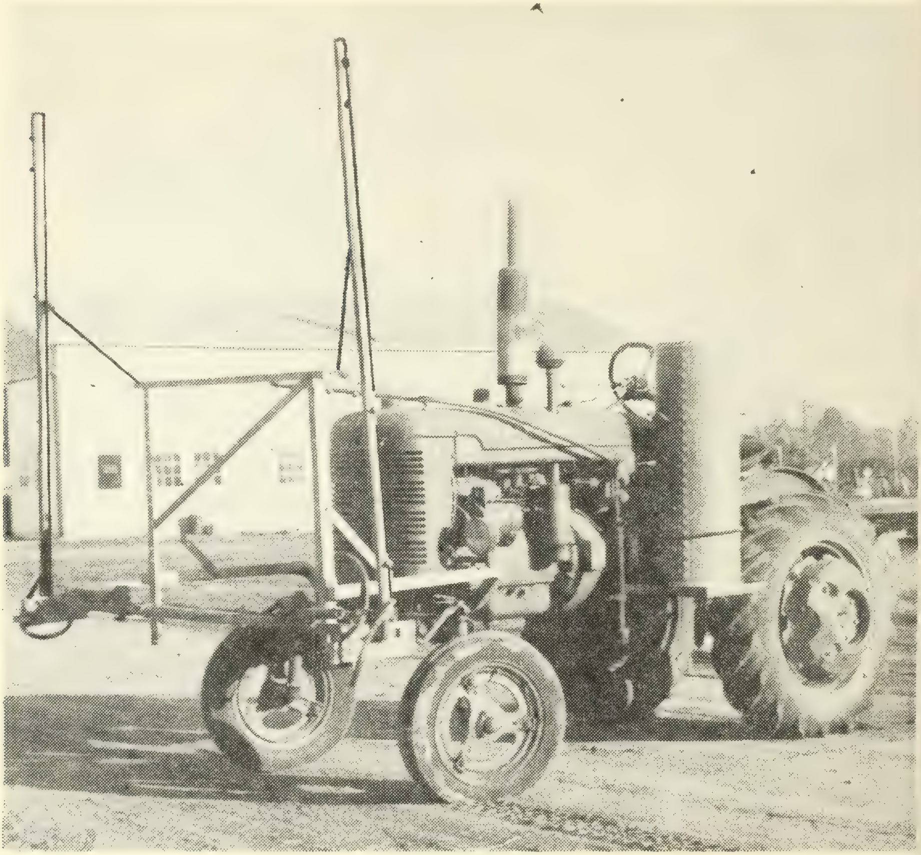


Figure 1: One row tractor with vertical tank mounting and conventional broadcast-type spray boom.

The wide variety of makes and models of tractors together with the many combinations of equipment used with them makes it impossible to give specific plans for the design and arrangement of the rig in every case. The simplicity of the rig itself should make it possible for the farmer to construct his own machine after a careful study of the sketches, photographs and instructions which are presented. Where there is no farm shop it will, of course, be necessary for some of the parts to be fabricated at some local machine or repair shop. Imagination, ingenuity and mechanical skill will allow many farmers to adapt the basic principles of the machine to their peculiar conditions. They can, and no doubt will in many cases, improve upon the machines described here.

The spray rig consists of a tank for the insecticide, a pump with the necessary strainers, valves, etc., for supplying pressure together with hose and piping to carry the liquid to the nozzles. The various component parts will be discussed in detail.

Tanks

While special tanks are available for spray machines, the average farmer will prefer to use one of low cost that is readily available. There are three convenient sources of supply. Many insecticide manufacturers ship their materials in 32-gallon metal drums which make excellent tanks. The standard 50-gallon oil drum is available for larger gallonage operations, or, where a small drum is indicated and the insecticide drum is not available, a 100-pound grease drum may be used.

The grease drum is mounted in the upright position as is shown in figure 1. The top is hinged to cover the opening and fitted with a simple latch. No outlets are provided in these drums and it will be necessary to drill a ½-inch hole in the bottom. Over this hole is brazed a ½-inch coupling, thereby forming the outlet to the pump.

The insecticide and oil drums are fitted with two openings in one end. They are mounted in the horizontal position with the smaller opening at the lowest point. This opening usually has ¾-inch pipe threads and a ¾-inch by ½-inch bushing is used to reduce the size of the opening to take the outlet hose connections.

The large opening is fitted with a street ell of a size determined by the opening itself. The regular drum plug then is used in the street ell as a filler cap. The use of the street ell provides a convenient means of filling the drum, figure 10.

Tank Mountings

The mounting of the tank is a problem peculiar to the individual tractor and its equipment. No set manner of building the mount or specifying a particular location can be made. The farmer must adapt his mounting arrangement to his equipment.

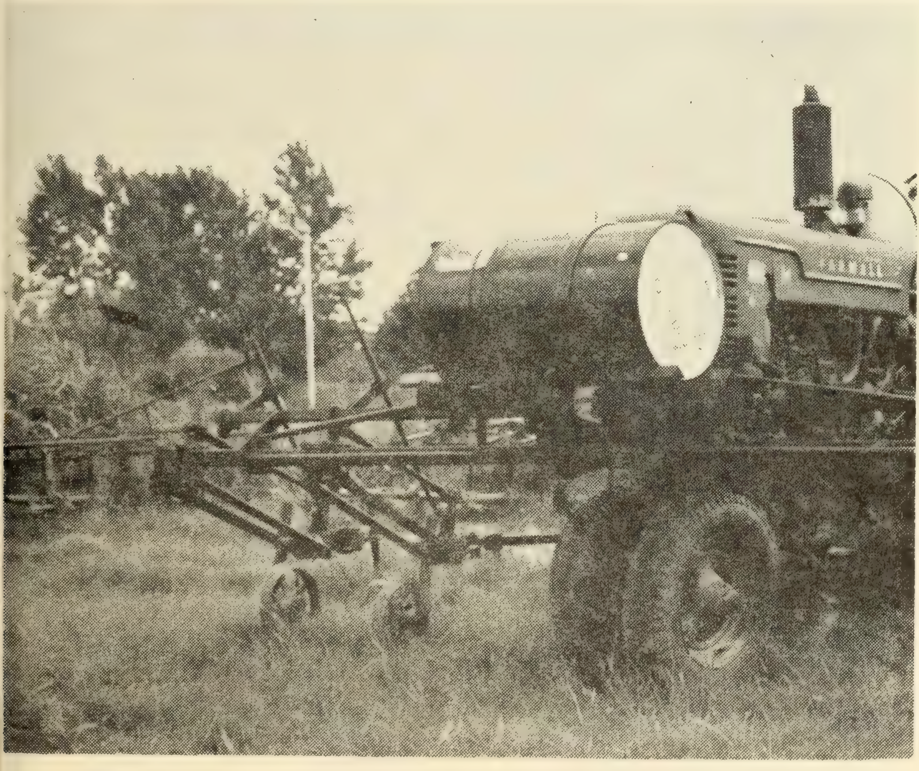


Figure 2: Front mounting for 32-gallon insecticide drum on 4-row cultivator.

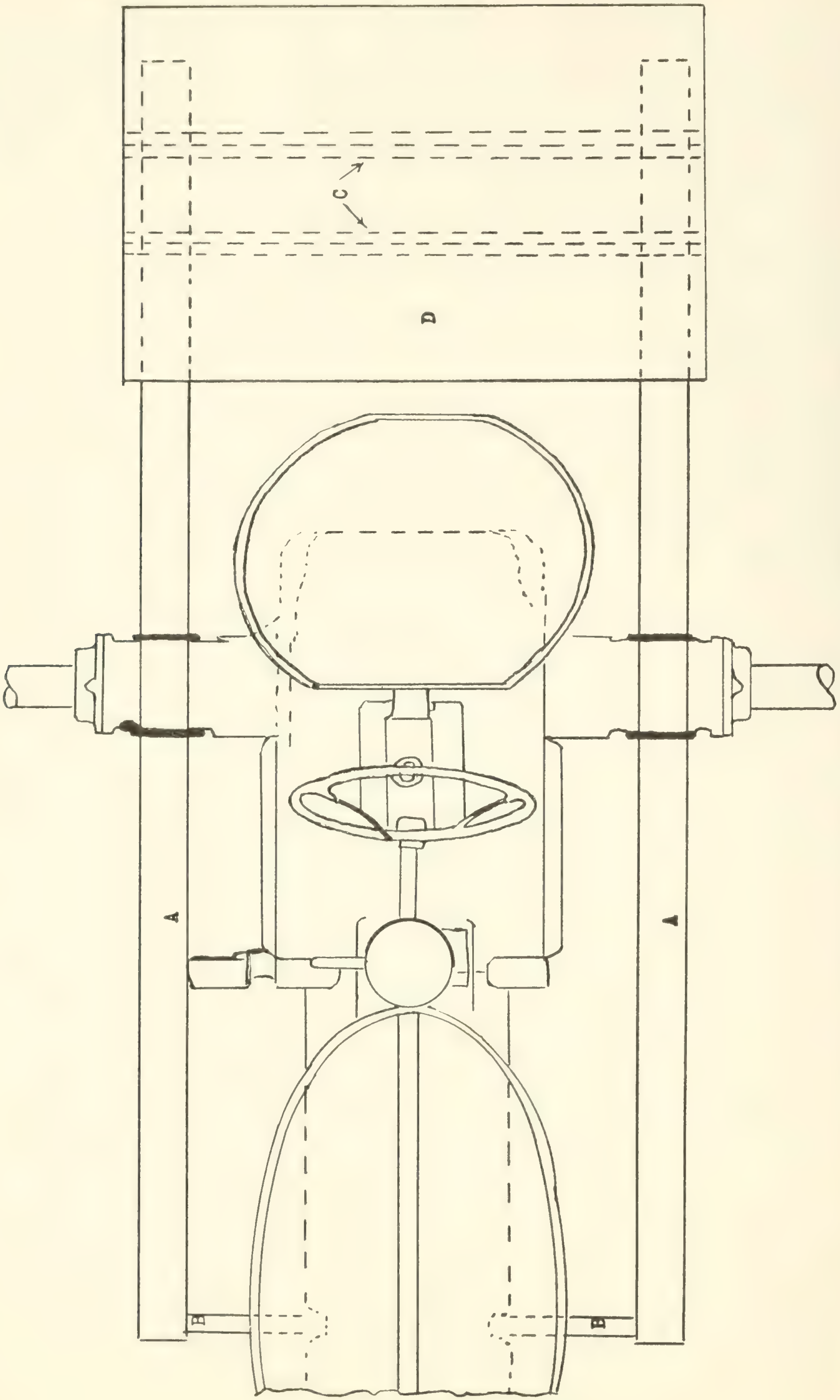


Figure 3. Overhead view showing method of mounting tank using side rail construction.

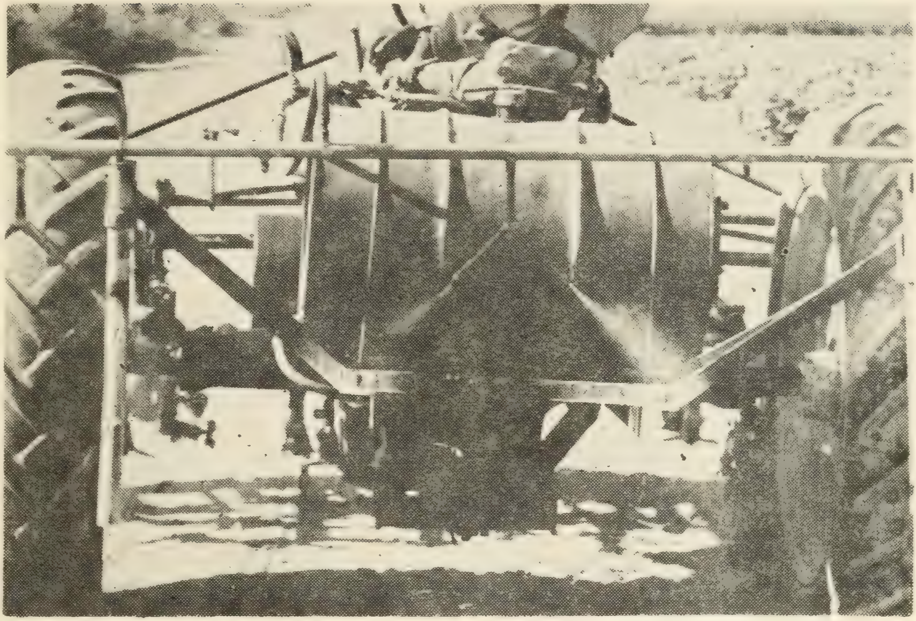


Figure 4: Rear mounted tank and boom showing three-point suspension of the tank.

The vertical type of tank mount is often used on tractors having mounting pads for the attachment of implements as is shown in figure 1. Here a bracket is made to fit the tank to be used and mounted with cap screws in the same manner as implements. This type of mounting will be found especially suitable for the small one-row outfits.

Where horizontal mountings are to be employed, angle irons welded to cross members offer a simple construction for the tank "cradle." The angles may be 1-½-inch by 1-½-inch or 2 inches by 2 inches of any thickness available and are cut the length of the tank. They are placed on the cross members with the angle up as shown in figure 2 and welded in position after spacing them to fit the diameter of the tank. The tank should be protected from the "cradle" by pads of belting, rubber, or some such resilient material. Discarded belts, inner tubes, etc., offer a source of supply. Rods or straps serve to hold the tank firmly in place. These straps should be formed to fit the tank and may be welded to the "cradle" at one end. One end should, however, be capable of being detached for removal of the tank. A bolt welded to the end of the strap and passing through a hole drilled in one of the angles of the "cradle" provides a positive means of adjusting the straps and allows quick removal of the tank when necessary.

Two general locations for the tank on larger tractors are front mounting and rear mounting. Where the tractor is equipped with a flame cultivator, anhydrous ammonia application machine and the like, the front mounting is used. Many times the front mounting will be preferred when the rear section of the cultivator is attached. When this mounting is used the mount may be attached to either the main frame or truss rods of the cultivator. The attaching members should be so constructed as to readily accomodate the "cradle" and tank and at the same time be amply strong to stand the shock

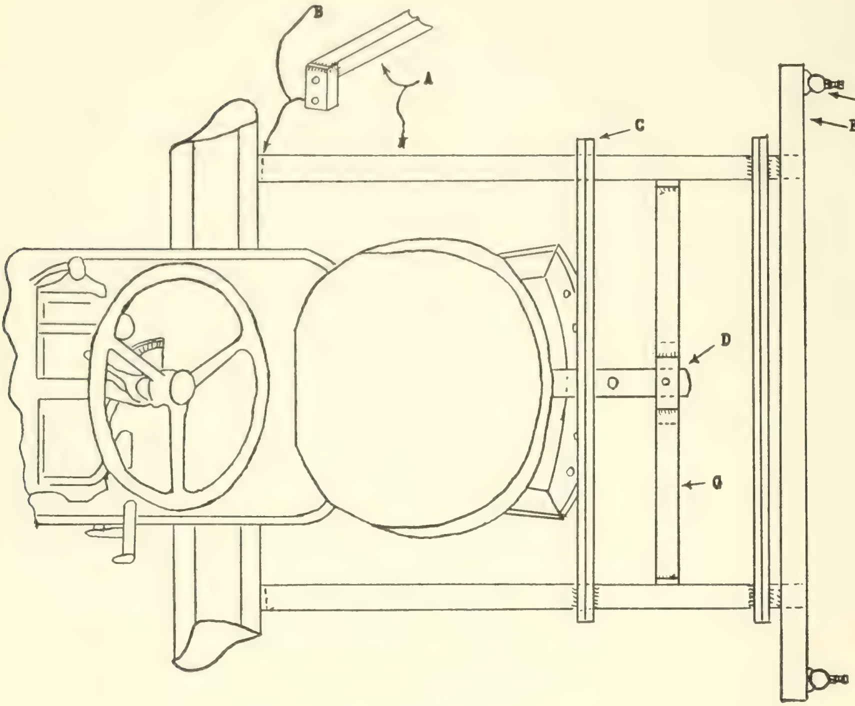


Figure 5. Sketch showing top view for the three-point suspension type of tank mounting.

and vibration incidental with field operation. A typical front mounting of a 32-gallon drum is shown in figure 2.

Where the rear mounting is employed, two types of mounts are the rule. In one, channel irons or pipes are used to form the members supporting the tank and "cradle." This construction is similar to that employed in attaching many flame cultivators and anhydrous ammonia machines. Pipe or tubing is usually the preferred material with 3-inch pipe being more commonly used. The channels, when used, should be about 3 inches in size and at least ¼-inch in thickness.

The side members of the mount are extended forward from the top of rear axle housings of the tractor and are attached with bolts and straps to the main frame or other attaching points near the middle of the tractor. "U" bolts secure the members to the rear axle housings. Care should be exercised to see that these side members extend far enough to the rear so as to clear the rear wheels should it be desired to mount a spray boom on them. Also, there must be clearance between the tank and the seat when the latter is in the lowest possible position. This is necessary to prevent interference of the seat and tank when operating or transporting the machine over rough fields or roads.

Another type of rear mounting is used on tractors having a draw bar which is always attached. This is a three-point suspension type and is shown in figure 4.

Here two pieces of angle are cut extending from the rear axle housings of the tractor rearward so as to provide clearance for wheels and seat as described previously. Figure 5 shows the construction and these angles as "A." These angles are usually 3 inches by 3 inches by ¼-inch. To the forward end of the angles a short piece of the same material is welded, extending downward, and is drilled to accomodate the implement attaching cap screws in the attaching pads on the axle housing. This is shown as "B" on the drawing. A piece of heavy strap iron (½-inch by 2½-inches) is cut approximately 10 inches in length and drilled in the center for bolting to the tractor draw-bar as is shown by "D". Next, two pieces of angle iron, "G", are cut to extend upward from the ends of this strap to the angle irons "A" when they are par-

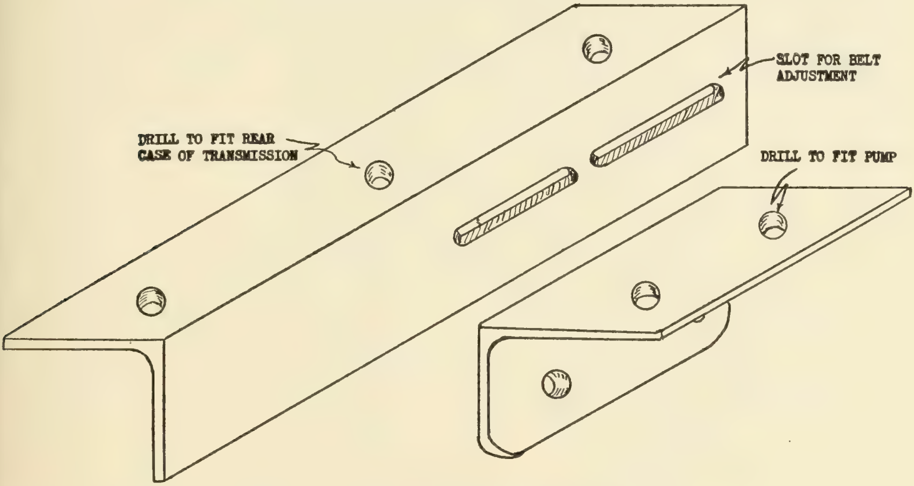

SLOT FOR BELT ADJUSTMENT
DRILL TO FIT REAR CASE OF TRANSMISSION
DRILL TO FIT PUMP

Figure 6: Pump bracket for Farmall H & M

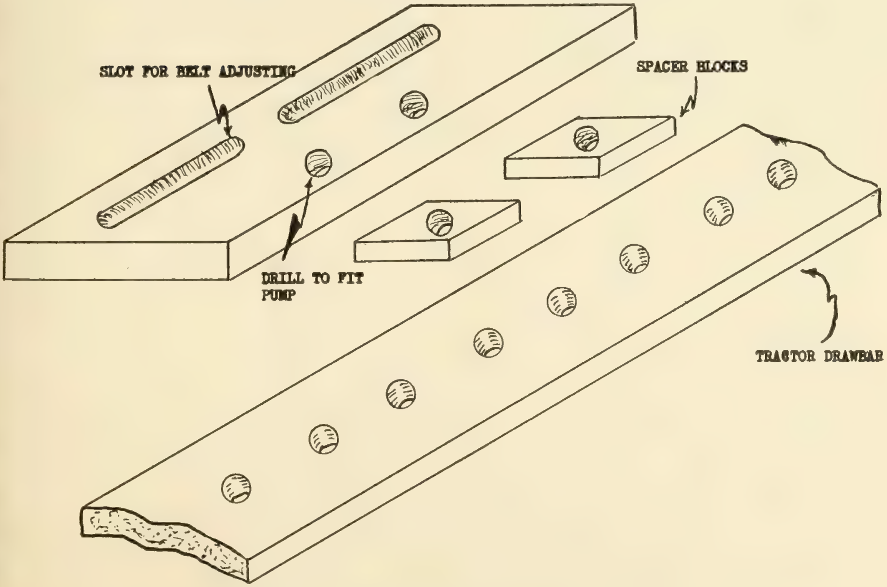

SLOT FOR BELT ADJUSTING
SPACER BLOCKS
DRILL TO FIT PUMP
TRACTOR DRAWBAR

Figure 7: Pump mount for John Deere A & B

allel with the ground. These angle irons, "G", form a V brace. The lower ends of this "V" are welded to the ends of the plate. In order to facilitate attaching the complete mount to the tractor the upper ends of the angle irons, "G", of the "V" are bent to lie flat against the sides of the angle irons "A." The two members are then drilled to accomodate a ½-inch machine bolt and are bolted together. The angle irons "C" are next cut to fit the tank length and are positioned to form the tank "cradle," being welded in place. When the rear mounted boom is used it is attached as shown at "E" and "F" and is described in detail later.

It is important in order to assume a positive supply of material from the tank to the pump at all times that the tank be mounted at the level of or preferably slightly above the pump.

Line Strainer

The line strainer, located between the pump and the tank, is most important as it serves a dual purpose in protecting the pump and nozzles from foreign matter. Line strainers are obtainable from the manufacturers of spraying equipment and accessories.

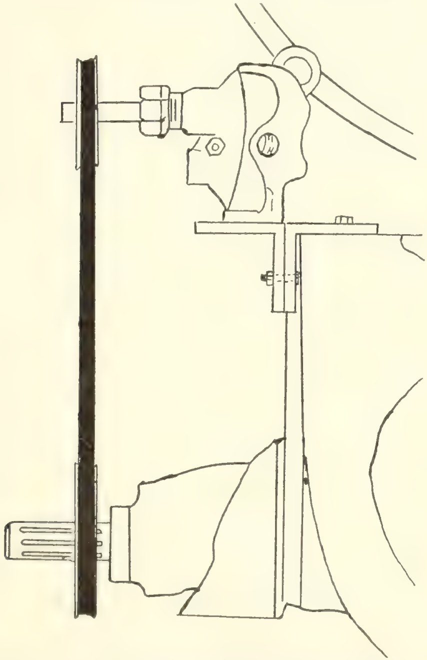


Figure 8: Belt driven gear pump mounted on on Farmall tractor.

Pumps

Several types of pumps are available such as the gear, paddle, roller and valve. In the development of this machine the bronze gear pump was used, being readily available. As a general rule the ½-inch or larger pump is to be recommended though smaller pumps may be used, especially on one-row units.

When insecticides are used that do not require agitation in the tank those pumps having a built in or internal bypass adjustment are satisfactory. If, however, the material requires agitation to maintain it in good physical condition for spraying, an external bypass valve or regulator should be used. The surplus liquid is bypassed back to the tank by means of a hose and hydraulic agitation is accomplished.

Pump Mountings

Pump drives are of three types. One is a pump connected directly to the power take-off shaft of the tractor by means of an adapter connection. While most of the newer tractors have power take-off shafts built to standard, it is always advisable to give the diameter of the shaft when ordering the pump and adapter. The second type is also a direct connected unit but it attaches to the power take-off shaft directly, no adapter being necessary. Here again the power take-off shaft size should be given.

The third is a standard pump designed to be driven by belts through sheaves or pulleys. Pumps of this type are mounted on the tractor with provisions being made to allow adjustment for the tightening of the belt. The size of the pulleys or sheaves used and the mounting location will determine the length of the belt. The sheaves used on the power take-off shaft and pump shaft should have a ratio of

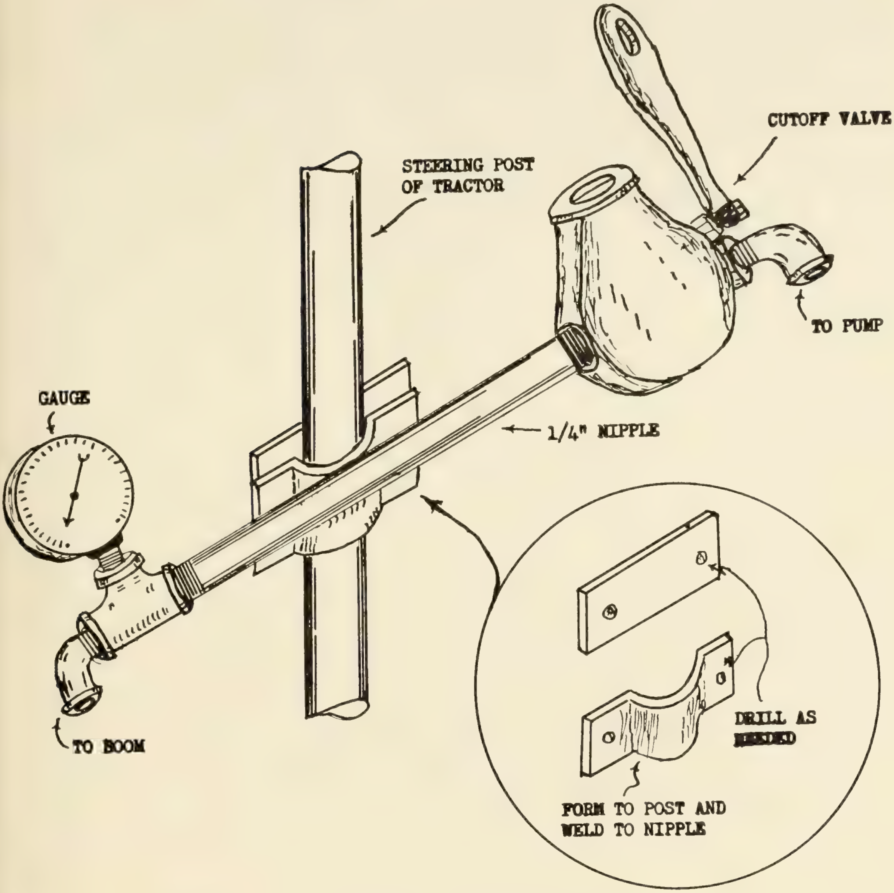


Figure 9: Valve and gauge mount for front mounted boom.

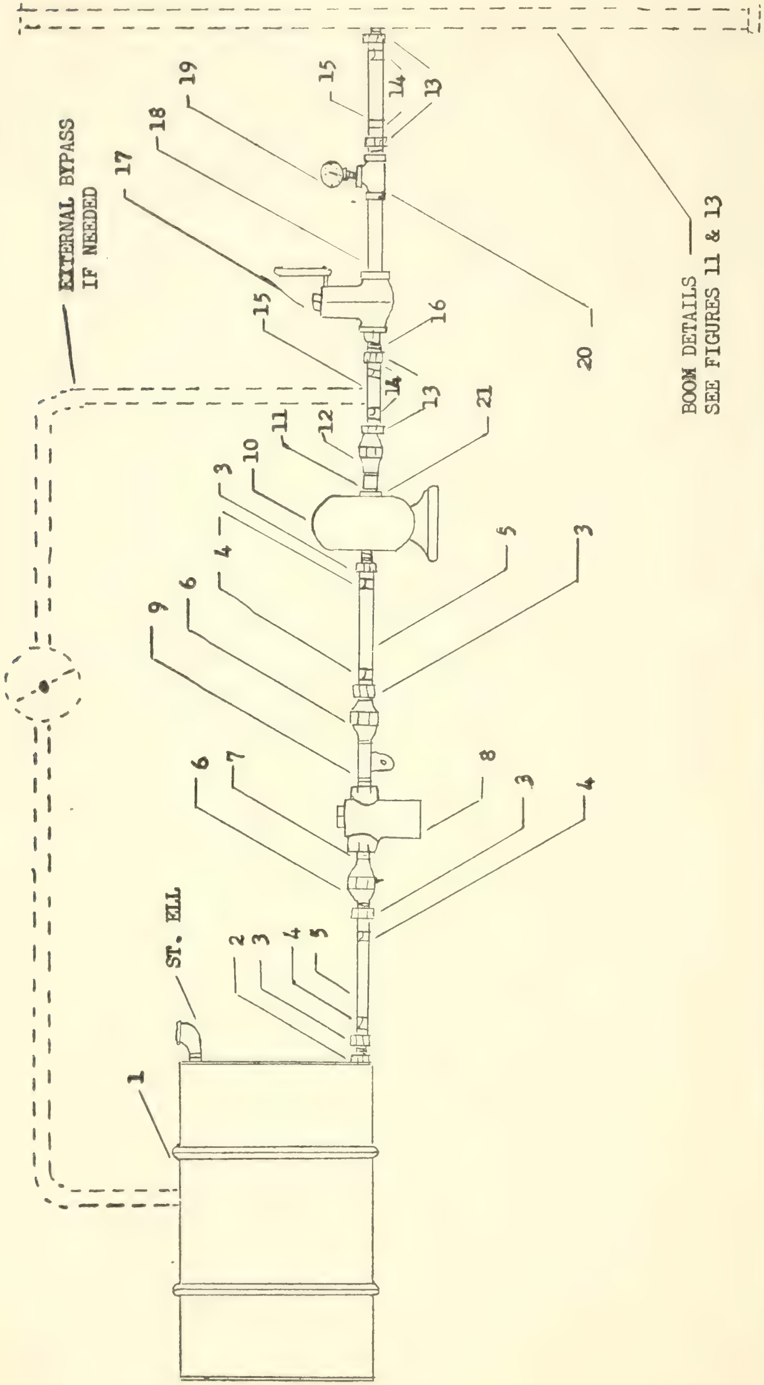
not less than 3:2, nor more than 2:1.

Mountings for the pump will vary with individual tractors. The pump mounting may be attached to the transmission case, or it may attach to the tractor draw bar. Modifications may be made so that a similar mounting can be fabricated for the particular make and model of tractor. A belt-driven pump is shown in figure 8. Care should be exercised to adjust the belt for tension. A belt that is too loose will cause the pressure to fluctuate because of slippage. One that is too tight will cause undue friction between the shaft and bearing resulting in excessive wear and subsequent pump failure.

Hose

The hose should be Neophrene both inside and out so as to withstand the action of the chemicals, oil, etc. This type of hose is sometimes referred to as "hot oil hose." The hose in the system from the tank to the pump is ½-inch and from the pump on through the boom and to the nozzles ¼-inch hose is used. Both ½-inch and ¼-inch hose ends will be required (see bill of materials) together with the necessary clamps.

The standard screw-type hose clamps may be used but the farmer with several machines using hose such as spray rigs, flame cultivators and anhydrous ammo-


EXTERNAL BYPASS
IF NEEDED
BOOM DETAILS
SEE FIGURES 11 & 13
ST. ELL
1
2
3
4
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6
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Figure 10: **Plumbing schematic. Numerals refer to item numbers in bill of materials**

Bill of materials

Item	Description	Size	4-row	2-row	1-row[1]
	Tank to Boom (Plumbing Schematic)				
1	Tank	15, 32, 55 Gal.	1	1	1
	Street ell	2"	1	1	
2	Bushing, reducing	¾" to ½"	1	1	
3	Shank, hose male	½"	4	4	
4	Clamp, hose	½"	4	4	
5	Hose, neophrene[2]	½"	10' to 20'	10' to 20'	
6	Union, ground	½"	2	2	
7	Nipple	½" close	1	1	
8	Strainer, line		1	1	1
9	Nipple	½" x 4"	1	1	
10	Pump	½"	1	1	
10	Pump	¼"			1
11	Nipple	¼" close	1	1	2
12	Union, ground	¼"	2	2	2
13	Shank, hose male	¼"	4	4	8
14	Clamp, hose	¼"	4	4	8
15	Hose, neophrene[2]	¼"	20' to 30'	20' to 30'	10'
16	Bushing, reducing[3]	⅜" to ¼"	1	1	1
17	Valve, quick cutoff	⅜"	1	1	1
18	Nipple	¼" x 4"	1	1	1
19	Gauge	0 to 100 PSI	1	1	1
20	Tee	¼"	1	1	1
21	Bushing, reducing	½" to ¼"	1	1	
	External pressure regulator[5]	½"	1	1	1
	Boom (Front Drop)				
	Nipples	¼" close	4	1	
	Union, ground	¼"	4	1	
	Cross	¼"	5	2	1
	Ell, 45°	¼"	8	4	2
	Ell, 90°	¼"	8	4	2
	Pipe	¼"	20'	10'	5'
	Tee	¼"	5	2	
	Shaft collar	⅝"	4	2	1
	Hose end	¼"	6	2	
	Clamp, hose	¼"	6	2	
	Boom (Rigid less Main Pipe)				
	Coupling, hose	¼"	12	6	
	Nipple	14" x 6"	5	3	
	Ell, 45°	¼"	2	2	
	"Y"[4]	¼"	3	1	
	Caps	1-¼"	2	2	
	Pipe, D. S.	1-¼"	14		
	Pipe, D. S.	¾"		8	
	Caps	¾"		2	
	Jets				
	Hollow cone	¼" male	12	6	3
	Plugs, pipe	¼"	8	4	2

---

[1] In fabricating one row machines, ¼" hose and fittings are used throughout.

[2] Hose lengths are approximate and are cut to fit individual installations.

[3] Optional.

[4] If it is impossible to obtain a "Y" fitting from stock, one may be fabricated as shown in figure 11. This will require an additional ell for a 2-row machine and three for a 4-row machine.

[5] If the pump is not equipped with an internal pressure regulating device then the external pressure regulator will be needed with additional hose and fittings.

Figure 10 illustrates item numbers

nia machines may find that an inexpensive tool for applying the clamps will be most desirable. These machines are simple to operate and the clamps are reasonably priced.

Gauge

The pressure gauge is standard and should have a dial reading of from 0 to 100 pounds per square inch. When the nozzles are front-mounted the gauge and quick cut-off valve (the valve is optional equipment) may be mounted on the steering column of the tractor, as is shown in figure 9. When a rear boom type rig is used the gauge is mounted directly in the boom and the valve, if used, is placed within easy reach of the operator.

Pipe and Fittings

The pipe and fittings used throughout should be black iron. The bill of materials gives the number used and description of all fittings necessary.

Booms

The type of boom used, its installation and location must, as in the case of tank mountings, be largely a matter of preference determined by the equipment being used on the tractor. Several types are satisfactory, the location of the spray nozzles with reference to the plants being basically the same on all. The plumbing plan or schematic is shown in figure 10.

The rear mounted boom, shown in figure 4, is mounted on the tank mounting in which the "cradle" has been modified to provide attaching points. Vertical pipes or standards are carried in set collars attached to the attaching points of the tank mounting. These standards are of 1-inch pipe approximately 30 inches long. To their tops a short piece of angle iron is welded extending toward the rear. These angle irons are drilled to accomodate a standard automobile muffler clamp of the proper size for the cross pipe or boom. The standards may be raised or lowered, giving height adjustment to the boom and the boom may be rotated in the muffler clamps for rotational adjustment. For still greater adjustment than is provided in the setting as shown, the standards may be removed from the collars and reversed, giving extremely low adjustments.

The boom should be of 1-inch pipe for 2-row machines and 1-¼-inch pipe for 4-row oufits. Row width will determine the length in either case. After the boom is cut to length both ends are capped. A ¼-inch hole is then drilled to accomodate the supply hose. This should be located slightly to one side of the end of the tank and on the top side of the boom. Over this hole is welded a ¼-inch pipe coupling to accomodate the supply hose from the pump. If the gauge is to be mounted in the boom itself another hole and welded coupling will be necessary. On the lower side of the boom holes are drilled to accomodate the nozzles and ¼-inch pipe couplings welded over them. These holes should be spaced along the boom at one-half the row width of the crop. This allows one nozzle to be directly over each row and one in each middle. Figure 11 shows a two-row section of such a boom when set up with three nozzles for late control. One nozzle would be used per row for early spraying with the two side nozzles removed and pipe plugs installed in their place. As the plants grow in size the two side nozzles would be used with the center nozzle outlet plugged. Still later this plug would be removed, the nozzle reinstalled and spraying would be with three nozzles per row as shown.

A simple front nozzle arrangement can be made by welding ⅝-inch set collars to the cultivator truss rods or frames directly over the row as is shown in figure 13. If so desired, the set collar can be welded to a clamp for attaching to either the frame or truss rod shown in detail in figure 12. This allows adjustment of the nozzles for various row widths. The

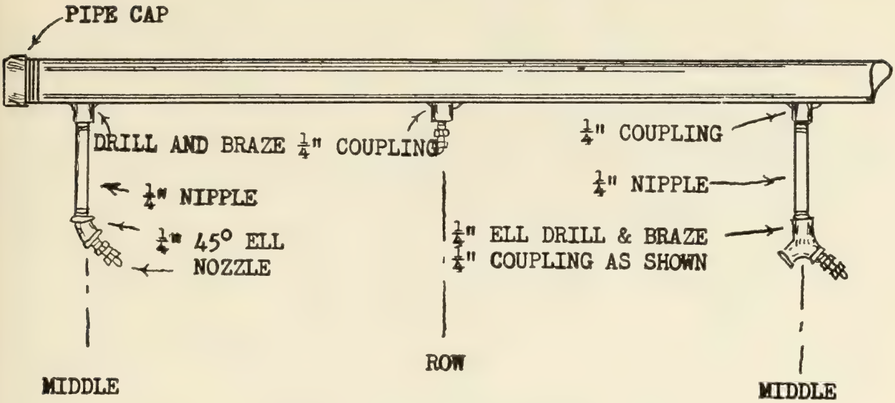
PIPE CAP
DRILL AND BRAZE ¼" COUPLING
¼" NIPPLE
¼" 45° ELL
NOZZLE
¼" COUPLING
¼" NIPPLE
¼" ELL DRILL & BRAZE
¼" COUPLING AS SHOWN
MIDDLE
ROW
MIDDLE

Figure 11: End section of rigid boom.

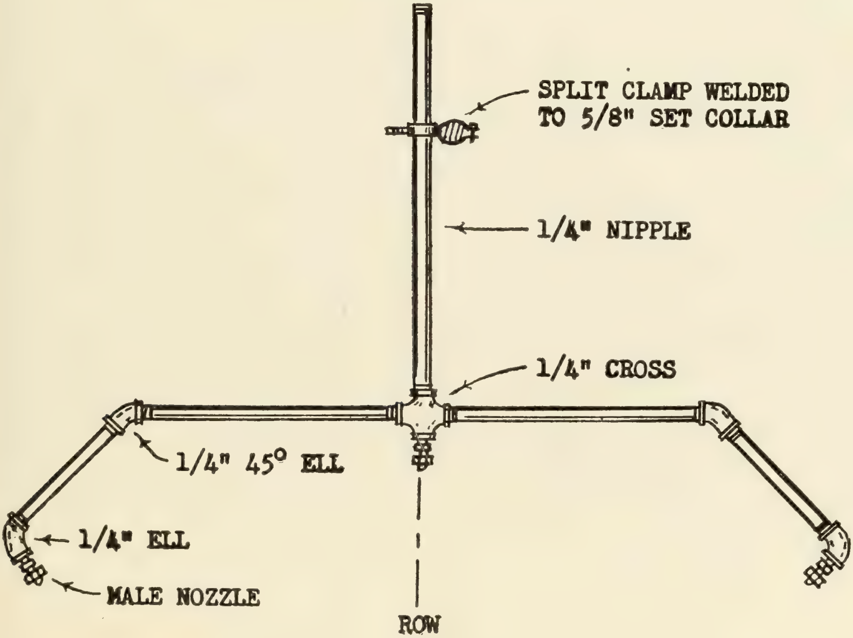
SPLIT CLAMP WELDED
TO 5/8" SET COLLAR
1/4" NIPPLE
1/4" CROSS
1/4" 45° ELL
1/4" ELL
MALE NOZZLE
ROW

Figure 12: Boom drops—one per row.

clamp must be made to fit the individual cultivator. One, two or three nozzles may be used per row as described above, the openings not in use being sealed with pipe plugs. The set collar allows adjustments to be made for height. This is a very simple and easy to fabricate arrangement but would not prove to be as satisfactory in large cotton as the adjustable boom type. The height of the cultivator frame from the ground will limit vertical adjustment in the upward position. Figure 14 shows this arrangement with the drop pipe reversed and set to use two nozzles per row. Figure 13 shows another arrangement with the down pipe in the up position, one side of the two-nozzle arrangement removed and the cross plug-

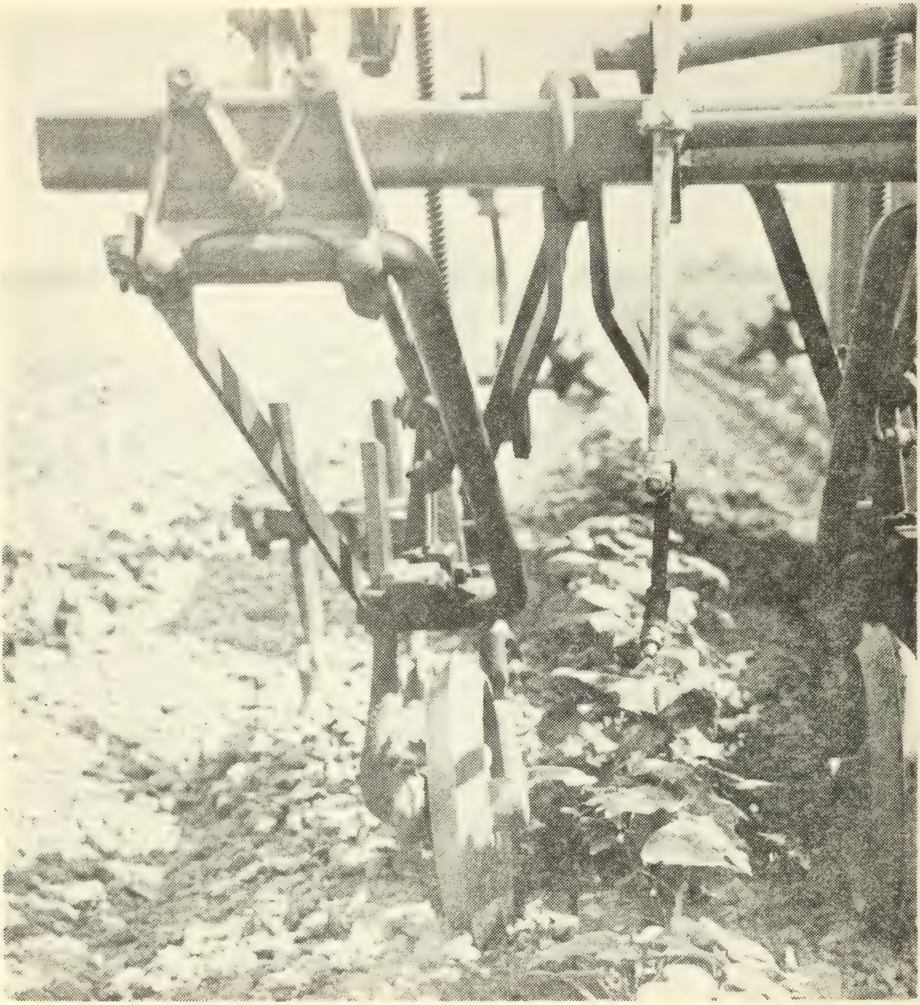

Figure 13: Front mounted boom drops showing set collar welded to cultivator and with one nozzle positioned over the row.

ged. The arm carrying the nozzle is positioned by adjusting the drop pipe in the set collar.

When flame cultivators are used farmers may wish to utilize the framework of this machine as a boom mounting. The tank must be mounted on the front similarly to the manner shown in figure 2. The boom is made as has previously been described and is attached to the main pipe frame of the flame cultivator either by welded standards or clamps.

Nozzles

The nozzles commonly used are standard ¼-inch male nozzles with 200-mesh strainer screws. The orifice or tips should be of the hollow cone type and with an output rating of one gallon per hour or .017-gallon per minute.

Calibration of The Machine

In view of the fact that jets will vary in their output from the manufacturers rating, the following method is suggested as an easy and accurate means of calibrating the machine.

The speed of the tractor in its various gears should be determined. It will be found that these speeds will vary somewhat from the manufacturers rated speeds, due to difference in individual machines, tire size, etc. The rated speeds will, however, usually serve, but in all spraying operations the tractor must be operated at full throttle to maintain power take-off speed.

The pressures usually used are from 30 to 40 pounds per square inch. Output of the nozzles may be varied somewhat by increasing or decreasing the pressure.

The tank of the spray rig should be completely filled (usually with water) and operated for a period of six minutes. The tank is then refilled and the amount required for refilling is measured. Several runs are preferable. After determining the average output of the system for six minutes, multiply this by 10 and the output per hour is the result.

A swath 100 inches wide and one mile long is one acre. Acres per hour, then, are determined by multiplying the swath

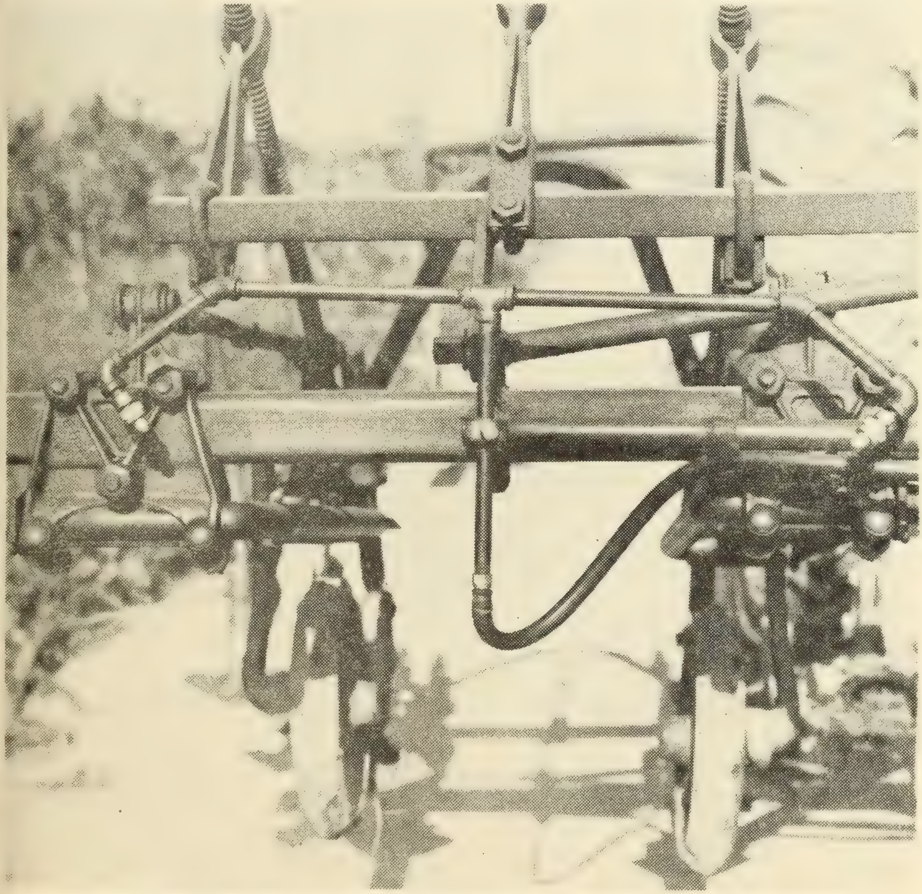

Figure 14: Drop boom in down position showing use of two nozzles per row.

width in inches by the speed of the tractor in miles per hour and dividing by 100.

$$\frac{\text{Swath width (inches) X MPH}}{100}=\text{Acres per hour}$$

The gallons per acre can now be determined by dividing the gallons per hour by the acres per hour. The complete formula is then:—

$$\frac{\text{GPH}}{\frac{\text{Swath width (inches) X MPH}}{100}}=\text{Gallons per acre}$$

Example: If the average output of the spray rig is .72-gallon in 6 minutes with 4-row equipment cultivating 40-inch rows at 3 miles per hour, then:—

$$\frac{0.72 \text{ X } 10}{\frac{160 \text{ X } 3}{100}}=\frac{7.2}{48}=1.5 \text{ gallons per acre}$$

The mixing of the insecticide in water is most important. Clean water should be used in all cases and the materials thoroughly mixed. Any material placed in the sprayer tank should first be strained. A convenient method of straining the materials and filling can be had by using a large funnel equipped with a screen of brass cloth in the throat. Such funnels can be obtained locally and are commonly used for straining the fuel into tractor tanks.

Any material still in the tank at the end of the operation may be drained into a covered container and used with the following day's supply. A thorough mixing of the old and new materials is necessary.

In any event at the end of each day's operation the tank should be drained and the system thoroughly cleansed. It is advisable to first remove all nozzle tips and strainers which should be washed in solvent or gasoline and left overnight in this material. The container in which the tips and strainers are placed should be covered. Next, the tank should be drained and flushed with clean water. The line strainer should be removed, thoroughly cleaned and reinstalled. After all connections are tight several gallons of clean water should be pumped through the system to insure proper flushing.

Care in mixing the insecticides and in cleaning the system will tend to eliminate stoppage in the field due to clogging.

In figure 10 is given the plumbing schematic for the spray system down to the boom. Booms are described elsewhere and figures 11 and 13 give details of boom sections.

In calibrating the machine slight variations in gallonage may be made by adjusting the pressure used. It is advisable to use the higher range of pressures and tractor operating speeds are, in the main, the determining factor in obtaining low gallonage spraying. When spraying with one nozzle per row the gallonage per acre should be from .6 to 1 gallon. With two nozzles the gallonage would be doubled or from 1.2 to 2 gallons per acre. In a like manner, three nozzles per row would require from 1.8 to 3 gallons per acre.

The farmer must, in order to operate at the speeds available to him through this gear change, pay particular attention to the details of making his crop. Good seedbed preparation together with a careful planting of his crop will naturally allow more efficient operation of his cultivating equipment and will permit him to operate at the required speeds for low gallonage spraying. Careless and inefficient field operations in making the crop may make it difficult, if not impossible, to attain the low gallonage necessary for efficient and economical spray application. Low gallonage spraying is a modern method of cotton insect control and as it is used in conjunction with the cultivating equipment, the cultivation of the crop will require methods and supervision as modern as the spray.

In all cases, the rig used should cover the same number of rows which were planted with the planter. A crop planted with a 2-row outfit should be sprayed with a 2-row spray rig. Likewise, 4-row planters can be followed with 4-row spray rigs. It is satisfactory, however, to use a 2-row spray rig where the crop has been planted with a 4-row planter, but 4-row rigs cannot satisfactorily be used in a crop planted with 2-row equipment. It is extremely important that the nozzles be in correct relation to crop row and plants and where the spray machine is wider than the planter, "guess" rows will cause variations in nozzle location and decrease the efficiency of the operation.

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BULLETIN 473 MAY 1950

Soil Fertility Practices
for
Cotton Production

In The Yazoo-Mississippi Delta

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
FRANK J. WELCH, Director

STATE COLLEGE MISSISSIPPI

Current Cotton Recommendations

(1) Apply 60 pounds of nitrogen per acre except where winter legumes have been turned under.

(2) Where a good growth of winter legumes is turned under, no additional nitrogen is needed. If poor stand or a poor growth prevails, commercial nitrogen should be applied accordingly.

(3) Apply nitrogen prior to planting or as an early side dressing. Pre-planting application has given slightly better results.

(4) If nitrogen is to be applied as a side dressing, make application immediately after cotton is cleaned out the first time.

(5) Apply anhydrous ammonia 6 to 8 inches deep on sandy loam soil and at a depth of 5 to 6 inches or as deep as conditions of soil will permit on clay soils. It must be sealed in the soil. Apply solid materials as deep as practical with available equipment.

(6) Apply phosphate and potash on a trial basis only, except where beneficial effect has been established. Soil analysis should be made to indicate need for trials.

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SOIL FERTILITY PRACTICES FOR COTTON PRODUCTION IN THE YAZOO-MISSISSIPPI DELTA

By PERRIN H. GRISSOM[1] [2]

One of the requirements for the economical production of cotton in the Yazoo-Mississippi Delta is that sufficient plant food be readily available to the cotton plant. It follows then that in most cases the natural fertility of the soil must be supplemented. Relatively high temperatures and high rainfall in this area cause a rapid decomposition of organic matter and favor the leaching of plant nutrients. As a result, all soils of the area are deficient in the amount of nitrogen necessary for maximum production of cotton. Phosphate, potash, and lime, either alone or in combination, may be needed in limited soil areas.

Recognition of the importance of nitrogen in the production of cotton by farmers in the Yazoo-Mississippi Delta can be pointed up by the following figures which show the nitrogen used and yields per acre for three 5-year periods:

Period	Av. no. of tons of actual nitrogen used annually	Av. yield in pounds of lint per acre
1930-1934	2647	219
1935-1939	8916	379
1944-1948	23,082	409

It is recognized that other factors have also contributed to the increases in yield per acre, but it is significant that the general trend of increased use of nitrogen and increased yields have been parallel.

The goal of more efficient cotton production can be attained only by reducing the cost of production at the present yield levels or by increasing the yield per acre without a proportionate increase in cost. It seems quite possible that, through the use of adequate amounts of fertilizer in the most efficient manner, yields can be increased without a proportionate increase in costs.

The Delta Branch Experiment Station has conducted fertilizer studies at Stoneville and on outlying fields since 1921. Much experimental information has been obtained. It is the purpose of this bulletin to review experimental findings and observations and to make recommendations based thereon.

It should be pointed out that, although treated as a separate practice herein, fertilization of cotton cannot be disassociated from other production operations. Efficiency of weed control, insect control, defoliation and harvesting, and the mechanization of cotton production in general will depend to a great extent on wise use of adequate fertilizer. Conversely, profitable returns from higher amounts of fertilizer are contingent on successful weed control, insect control, and in many cases defoliation. To repeat, although fertilizer may be the limiting factor in the production of cotton, maximum benefits from a good fertilizer program cannot be realized without regard to other good farming practices.

A discussion of fertilization of cotton should include: (1) What fertilizer to apply, (2) how much to apply, (3) when to apply it, and (4) how to apply it. Because of its relative importance, nitrogen will be discussed with special reference to these four considerations and the other plant nutrients treated separately.

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[1] Agronomist, Delta Branch of the Mississippi Agricultural Experiment Station.

[2] Credit is due the agricultural engineers of the Divisions of Agricultural Engineering, B.P.-I.S.A.E., U. S. Dept. of Agriculture, and the Delta Branch of the Mississippi Agricultural Experiment Station for construction of experimental fertilizer distributors used in this study.

Much of the early data reported in this bulletin were collected by Mr. Roy Kuykendall, superintendent of Coastal Plain Branch of the Mississippi Agricultural Experiment Station, located at Newton, and Dr. John B. Pitner, soil scientist, Rockefeller Foundation, Mexico City, Mexico, both formerly with the Delta Branch Experiment Station.

Sources of Nitrogen

As has been pointed out, nitrogen must be supplied for high yields. This may be accomplished through the use of commercial nitrogen or by turning under legume crops.

Commercial Sources of Nitrogen.—In 1921 the first experiment designed to compare sources of commercial nitrogen for cotton was begun at the Delta Branch Experiment Station. It has been continued since that time. The experiment was located in a well-drained, fine sandy loam, low terrace soil. Six sources of nitrogen; namely, nitrate of soda, ammonium nitrate, cyanamid, ammonium sulphate, cottonseed meal, and a mixture

Table 1.—The influence of sources of commercial nitrogen on the yield of cotton Delta Branch Experiment Station, 1921-1949[1]

Year	No nitrogen	Sodium nitrate	Ammonium nitrate	Ammonium Sulphate	Cyanamid	Cottonseed meal	½ cottonseed meal & ½ Sod. Nit.
	Yields in pounds of seed cotton per acre						
1921	1459	1731	1695	1740	1481	1634	1627
1922	749	808	802	872	771	899	919
1923	508	680	722	766	558	530	738
1924	1392	1496	1603	1532	1431	1609	1486
1925	2779	3041	3125	3171	3202	3223	3308
1926	2065	2992	2909	2740	2647	2160	2239
1927	1598	2626	2301	2049	2215	1940	2720
1928	1641	2301	2287	2169	2298	2040	2063
1929	1485	2122	2061	1898	1754	1838	1932
1930	967	1284	1116	959	1056	1122	1242
1931	1217	1730	1636	1545	1580	1678	1607
1932	672	1057	958	1027	962	929	986
1933	1085	1520	1575	1559	1610	1616	1562
1934	751	1097	1145	1135	1002	970	953
1935	1058	1601	1476	1447	1490	1435	1322
1936	839	1132	1255	1206	1205	1219	1233
1937	964	1931	1722	1571	1654	1483	1622
1938	1193	1865	1863	1812	1706	1723	1727
1939	967	1452	1455	1569	1503	1517	1539
1940	956	1559	1536	1501	1596	1390	1443
1941	1115	2155	2011	1865	1858	1700	1714
1942	1024	1632	1852	1734	1873	1714	1705
1943	913	1156	1534	1492	1495	1419	1393
1944	816	1419	1504	1313	1402	1226	1278
1945	773	1653	1628	1478	1576	1609	1549
1946	837	1354	1448	1395	1458	1291	1292
1947	915	1518	1649	1670	1692	1502	1421
1948	985	1616	1613	1641	1552	1605	1501
1949	854	1451	1472	1391	1452	1310	1266
Av. 1st 9 yrs.	1520	1977	1945	1882	1817	1764	1892
Av. 2nd 9 yrs.	972	1469	1413	1362	1363	1353	1362
Av. 3rd 9 yrs.	924	1544	1624	1556	1606	1495	1482
Average 29 yrs.	1123	1654	1653	1595	1589	1529	1565
Increase over no nitrogen		531	530	472	466	406	442

[1] All materials applied at the rate of 30 pounds of nitrogen per acre.

Table 3.—Influence of sources of nitrogen on yield of cotton at Yazoo City, Mississippi, 1946-49

Treatment[1]	Pounds of seed cotton per acre					Average increase over no nitrogen
	1946	1947	1948	1949	Average yield	
No nitrogen	1283	1788	1513	1398	1496	----
Nitrate of soda	1515	2176	2136	2257	2021	525
Anhydrous ammonia	1547	2206	2028	2205	1997	501
Ammonium nitrate	1508	2171	1995	2139	1953	457
Ammonium sulphate	1583	2169	1923	2044	1930	434
Cyanamid	1446	2246	1835	2080	1902	406

[1] Each treatment represents an average of rates of 30, 45, and 60 pounds of nitrogen per acre.

consisting of one-half cottonseed meal and one-half nitrate of soda, have been compared at a uniform rate of 30 pounds of nitrogen per acre. A rotation of cotton-oats-corn has been practiced for most of the duration of the test with each plot fertilized the same each year, regardless of the crop. The 29-year results of the test are shown in table 1.

These data show that nitrate of soda and ammonium nitrate have produced slightly larger increases in yield than the other sources. Cottonseed meal has not been a satisfactory source of nitrogen.

At the end of the first 20 years, analyses were made of soil samples taken from the plots treated with nitrate of soda, ammonium sulphate, and the untreated plots. The results showed that plots treated with ammonium sulphate had a pH of 6.30, untreated plots had a pH of 6.70, and plots treated with nitrate of soda had a pH of 7.0. The ammonium sulphate plots were also slightly lower in total exchangeable bases. However, the increasing acidity has not been reflected in a downward trend in yield. The plots treated with ammonium sulphate have yielded slightly less than the nitrate of soda plots, but differences do not appear to be related to the length of the test. The slowly increasing acidity may eventually be reflected in lower yields.

Since initiation of the first sources-of-nitrogen experiment with cotton, several other tests have been conducted at various locations in the Delta, with the objectives of testing new materials and of studying crop responses to different sources of nitrogen on divergent soil conditions. A summary of data collected is shown in table 2. Average increases in yields show nitrate of soda to be slightly better than the other materials with only a small difference between any of the sources of nitrogen. The higher average yields obtained from nitrate of soda can be attributed to results of tests conducted in the eastern part of the Delta near the hills. On these soils a benefit was apparently derived from the sodium contained in the nitrate of soda.

In keeping with the policy of testing new nitrogenous fertilizers, a series of experiments was begun in 1945 to compare anhydrous ammonia with the most commonly used nitrogenous materials. In these tests anhydrous ammonia, ammonium nitrate, nitrate of soda, cyanamid, and ammonium sulphate at rates of 30, 45, and 60 pounds of nitrogen per acre were compared with no nitrogen. These experiments were located at Stoneville, Yazoo City, Money, Valley Hill, and Onward. Initial applications of the anhydrous ammonia were made in cooperation with Dr. W. B. Andrews and Mr. F. E. Edwards of the Central Station.

Table 3 shows a summary of the results obtained from the experiment at Yazoo City. The test was located on a well drained, fine sandy loam, low terrace soil and was conducted in cooperation with Emile Schaefer and the late Marx Schaefer. The 1945 results varied considerably because of residual effect from a cover crop, and the data for that year were discarded. In 1948 nitrate of soda was significantly better than the other sources of nitrogen. There were indications of potash deficiencies in the test in that year, which might account for the superiority of the nitrate of soda. Considerable burning of the young cotton plants resulted from the cyanamid in 1948. No rain occurred between the time the fertilizer was applied and planting time. As a result, sufficient moisture was not available for a chemical change of the cyanamid, which caused it to be toxic to young cotton plants. Other than the exceptions noted, there were no significant differences between the sources of nitrogen in their influence on yield.

The 3-year results of the sources-of-nitrogen test at Money, table 4, conducted in cooperation with H. L. Gary show no significant differences between the materials. This test was located on a low terrace soil ranging from a silty clay loam with fair internal drainage to a fine sandy loam with very good internal drainage. Increased yields from nitrogen were lower than would normally be expected.

The data from the test located on Reality Plantation at Onward, Mississippi, conducted in cooperation with James Hand are reported in table 5. The 2-year averages show a slight, although not statistically significant, advantage for anhydrous ammonia; otherwise there were no differences. This test was located on a well drained, fine sandy loam, low terrace soil.

At Valley Hill the test was located on a well drained, silt loam, first bottom soil, and was conducted in cooperation with L. S. Hemphill. Yields of this test are reported in table 6. Variations in the experiment have been so great that the data have little value, except for the 1948 results from nitrate of soda. That year there was considerable "rust" in the test and in the adjacent cotton. Where nitrate of soda was applied, there was a marked depression in the amount of "rust" and an accompanying increase in yield.

Table 4.—Influence of sources of nitrogen on yield of cotton at Money, Mississippi, 1946-48

Treatment[1]	Pounds of seed cotton per acre				Average increase over no nitrogen
	1946	1947	1948	Average yield	
No nitrogen	1372	1464	1484	1440	----
Ammonium nitrate	1632	1989	1864	1828	388
Nitrate of soda	1609	1950	1874	1811	371
Cyanamid	1620	1917	1853	1796	356
Ammonium sulphate	1579	1962	1820	1787	347
Anhydrous ammonia	1528	1953	1870	1783	343

[1] Each treatment represents an average of rates of 30, 45, and 60 pounds of nitrogen per acre.

Table 5.—Influence of sources of nitrogen on yield of cotton at Onward, Mississippi, 1947-48

Treatment[1]	Pounds of seed cotton per acre			Average increase over no nitrogen
	1947	1948	Average yield	
No nitrogen	838	1143	990	----
Anhydrous ammonia	1528	2217	1872	882
Ammonium nitrate	1474	2098	1786	796
Nitrate of soda	1390	2171	1780	790
Cyanamid	1475	2084	1779	789
Ammonium sulphate	1448	2072	1760	770

[1] Each treatment represents an average of rates of 30, 45, and 60 pounds of nitrogen per acre.

Results of the experiment conducted on a well-drained, fine sandy loam, low terrace soil at Stoneville are shown in table 7. Except for 1949, there were no significant differences in yields between the different materials. However, in 1949 nitrate of soda produced smaller increases in yields than the other nitrogen sources. The experiment was affected by Verticillium wilt. In three of the four replications, cotton on the plots treated with nitrate of soda at the rates of 45 and 60 pounds of nitrogen per acre was more severely damaged than other plots in the test. Whether this occurred by chance or whether higher rates of nitrate of soda aggravated the wilt damage will have to be determined by further study.

When the results of the tests located at Stoneville, Yazoo City, Money, and Onward are averaged, the increase in yield over the untreated plots from the different sources of nitrogen are as follows:

Source	Pounds of seed cotton per acre
Anhydrous ammonia	509
Ammonium nitrate	509
Nitrate of soda	488
Ammonium sulphate	478
Cyanamid	456

If all the data comparing sources are considered, it can be concluded that, based on yields alone, there is little difference between the nitrogenous materials tested with three exceptions; namely, (1) in soils near the hills formed from hill alliuvium, nitrate of soda produced the highest increase in yield per pound of nitrogen; (2) the application of cyanamid without a sufficient lapse of time before planting cotton has in some cases produced harmful effects in the young cotton, which has been reflected in slightly lower yields from cyanamid than from other sources; (3) cottonseed meal has not been a satisfactory source of nitrogen.

There are factors other than yields which should be considered in choosing between the sources of commercial nitrogen. Cost, of course, is the major consideration. At present prices, anhydrous ammonia affords the cheapest source of nitrogen. Ammonium nitrate is the cheapest source of nitrogen in solid form. Based on current retail prices, the approximate costs of materials for fertilizing an acre of cotton at the rate of 60 pounds of nitrogen are as follows:

Anhydrous ammonia	$4.50-$5.00
Ammonium nitrate	6.50
Ammonium sulphate	8.00
Cyanamid	9.00
Nitrate of soda	11.50

The cost of applying anhydrous ammonia is slightly higher than for the solid materials, which would reduce the initial price advantage somewhat.

The ease of application varies considerably with the different solid nitrogenous materials. Nitrate of soda and cyanamid possess characteristics that facilitate their application. Ammonium nitrate varies considerably with the different manufacturers. The poorest quality ammon-

Table 6.—Influence of sources of nitrogen on yield of cotton at Valley Hill, Mississippi, 1945-48

Treatment[1]	Pounds of seed cotton per acre				Average increase over no nitrogen
	1945	1946	1948	Average yield	
No nitrogen	1010	1337	1146	1164	—
Nitrate of soda	1368	1647	1723	1579	415
Ammonium nitrate	1382	1748	1307	1479	315
Anhydrous ammonia	1160	1665	1467	1430	266
Cyanamid	1318	1542	1309	1389	225
Ammonium sulphate	1108	1661	1354	1374	210

[1] Each treatment represents an average of rates of 30, 45, and 60 pounds of nitrogen per acre.

ium nitrate is very difficult to apply under damp conditions. However, the better quality material can be applied almost as easily as nitrate of soda or cyanamid. Ammonium sulphate also varies with the manufacturers, but it appears that newer forms available this year have a better physical condition. Much of the ammonium sulphate that has been available in recent years has been so difficult to apply, particularly under damp conditions, that the farmer could well afford to pay considerably more for better quality nitrogenous materials.

The need for good physical condition in nitrogenous materials is recognized. However, there has been a tendency to overlook the fact that even with best quality materials, the degree of accuracy in application of solid forms of nitrogen is very low due to the mechanical distributors that are available to the farmer and to the failure of the farmer to calibrate the machines that are available. Much improvement is needed in tractor-mounted fertilizer distributors for row crops.

Whereas the successful application of solid materials is limited by physical conditions and the machines for applying them, the biggest problem involved in applying anhydrous ammonia is that of adequately sealing it in the soil. It is absolutely necessary that anhydrous ammonia be covered simultaneously with its application. Because of this necessity, anhydrous ammonia loses some of its advantage over solid materials on trashy or stumpy land and on clay soils. Anhydrous ammonia has been applied successfully on buckshot soils, but care must be exercised in selecting the time to apply it; and close supervision is needed during the actual application. Anhydrous ammonia can usually be applied more accurately than solid materials, and it also affords more flexibility in placement.

Legumes

Winter Legumes as a Source of Nitrogen.—The possibility of supplying a portion of the nitrogen requirements by turning under winter legumes has received considerable attention by the Delta Station. The first winter legume experiment at Stoneville was begun in 1929. The purpose of this test was to compare the fertility value of winter legumes and rye with 30 pounds of commercial nitrogen. The experiment is being continued. Changes have been made as they appeared desirable. Results obtained in this experiment are shown in table 8. (See page 12) The first three years' data have been eliminated because of poor stands.

During the period 1933-38, the highest average yield of cotton followed hairy vetch. Austrian winter pea, California bur clover, and melilotus indica, in order of their beneficial effect, also resulted in greater yield increases than 30 pounds of commercial nitrogen. The yields following rye were reduced.

Average yields for the period 1939 to 1946 show that the highest yields were

Table 7.—Influence of sources of nitrogen on yield of cotton at the Delta Branch Experiment Station, 1945-49

Treatment[1]	Pounds of seed cotton per acre						Average increase ovei no nitrogen
	1945	1946	1947	1948	1949	Average yield	
No nitrogen	2385	1461	1727	2189	1490	1850	....
Ammonium nitrate	2760	2085	2262	2740	1935	2356	506
Ammonium sulphate	2712	2128	2133	2692	1956	2324	474
Anhydrous ammonia	2617	2058	2197	2761	1938	2314	464
Nitrate of soda	2632	1938	2291	2696	1735	2258	408
Cyanamid	2655	1945	2102	2673	1986	2272	422

[1] Each treatment represents an average of rates of 30, 45, and 60 pounds of nitrogen per acre.

obtained following California bur clover, hairy vetch, and Giant bur clover, respectively. The differences between the three were small. The Austrian winter peas were seriously affected by a disease which resulted in lower average yields than those produced by 30 pounds of commercial nitrogen.

It is interesting to note that in 1948, when the rate of nitrate of soda was increased to 45 pounds of nitrogen per acre, the resulting cotton yields were higher than those on any of the winter legume plots except giant bur clover; whereas, in 1949 all legume plots produced higher yields than nitrate of soda applied at the rate of 45 pounds of nitrogen.

After the legume study, begun in 1929, had been in progress for 12 years, analyses were made of soil samples taken from the different plots at varying depths. The results of the analyses of the 0- to 6-inch and 6- to 12-inch layers are shown in table 9.

Results shown in table 9 indicate that the calcium, magnesium, and active mineral elements in the 0- to 6-inch and 6- to 12-inch layers were lower where legumes were grown than where nitrate of soda was applied. The acidity was increased on the legume plots more than on the nitrate of soda plots. The hairy vetch plots were slightly higher in organic matter than the nitrate of soda plots, but the other legume plots were slightly lower. Differences in organic matter between any of the legumes and the nitrate of soda plots were very small. The rye and untreated plots were lower in organic matter than the other treatments.

In the analyses of layers of soil taken at greater depths (data are not shown), the amount of calcium, magnesium, and active mineral elements were higher in the hairy vetch plots than on the nitrate of soda plots. This was most pronounced at the 36-to 48-inch depth.

Since establishment of the first winter legume study, several experiments have been conducted to determine the suitability of different legumes on different soils at various locations in the Delta. A summary of the data collected in these tests is shown in table 10. The data show that hairy vetch led in these tests. It increased the yield of seed cotton more than 30 pounds of commercial nitrogen.

Table 9.—Soil analysis showing the effect of turning under winter legumes and rye for 12 years with comparisons with nitrate of soda and untreated plots, Delta Branch Experiment Station

	0"—6"					
Treatment	Exchangeable calcium	Exchangeable magnesium	pH	Percent organic matter	Total base exchange capacity	Lime requirement (Pounds) per acre)
No treatment	10.80	4.45	6.75	1.64	13.44	360
Rye	8.64	3.28	6.70	1.62	12.75	128
Nitrate of soda	9.70	4.88	6.90	1.86	13.31	128
Hairy vetch	9.40	4.14	6.55	1.95	12.02	276
Austrian winter peas	8.83	3.58	6.55	1.78	11.71	212
California bur clover	9.06	3.76	6.50	1.83	13.20	402
			6"—12"			
No treatment	12.10	6.10	6.75	1.16	15.60	276
Rye	12.40	4.76	6.70	1.20	15.27	234
Nitrate of soda	12.15	6.60	6.75	1.23	16.33	106
Hairy vetch	11.90	6.22	6.60	1.21	15.54	340
Austrian winter peas	11.80	4.19	6.70	1.18	15.18	190
California bur clover	11.94	4.95	6.50	1.19	15.74	340

Other experiments have been conducted to test other legumes that appeared to have possibilities. Some of these tested that proved unsatisfactory were melilotus indica, red clover, alsike clover, white Dutch clover, common vetch, and Hungarian vetch. More recently, Dixie Wonder peas, an early strain of Austrian winter peas, have come into the picture. Tests at Stoneville have shown them to be susceptible to the same diseases as Austrian winter peas and also susceptible to extreme cold weather. Although no tests have been conducted in the South Delta, they may be satisfactory if not grown more than 2 or 3 years consecutively on the same land. There is one other possibility, based on observations, for Dixie Wonder peas to be used to a good advantage. By planting in August, sufficient growth may be produced for turning under in late November or December. This merits further study.

In the fall of 1945 an experiment was begun at Stoneville to compare the winter legumes that appeared to have the greatest possibility for Delta conditions, with 40 pounds of commercial nitrogen per acre. The 5-year results are listed in table 11.

In this experiment 40 pounds of commercial nitrogen have been equal to the best of the winter legumes. The poor results from the winter legumes in 1949 can be attributed to a severe red spider attack in the fall of 1948. The stand was damaged, and very little growth was made in the spring. Whether red spiders may have to be reckoned with in the future is unpredictable.

When all of the results from the winter legume studies are considered, hairy vetch, wild winter peas, and Giant bur clover have performed the best. Increases in yield that have resulted from their use have been equal to about 40 to 60 pounds of commercial nitrogen per acre. There is a possibility that the cumulative effect from legumes may be greater than for commercial nitrogen over a long per-

Table 10.—Average increases in yield of seed cotton from different winter legumes with comparisons with commercial nitrogen in the Yazoo-Mississippi Delta, 1936-39

Treatment	Pounds of seed cotton per acre				
	Yazoo City	Valley	Valley Hill	Charleston	Average
No nitrogen	----	----	----	----	—
Nitrate of soda[1]	375	282	379	517	388
Austrian winter peas	341	294	290	58	242
Hairy vetch	426	313	383	462	396
Hungarian vetch	281	193	269	194	234
California bur clover	390	71	355	318	284
Giant bur clover[2]	318	206	252	132	227

[1] Nitrate of soda applied at the rate of 30 pounds of nitrogen per acre.

[2] Giant bur clover was not handled in customary plantation manner, resulting in low increased yields.

Table 11.—Influence of winter legumes on yield of cotton with comparisons with 40 pounds of commercial nitrogen, Delta Branch Experiment Station, 1945-49

Treatment	Pounds of seed cotton per acre					
	1945	1946	1947	1948	1949	Average
Giant bur clover	2836	2308	1954	2697	1497	2258
40 pounds nitrogen[1]	2842	2222	1904	2578	1607	2231
Wild winter peas	2768	2207	1895	2527	1494	2178
Hairy vetch	2486	2023	1847	2593	1533	2096
Manganese bur clover	2762	1865	1862	2394	1384	2053
Willamette vetch	2495	2168	1711	2328	1470	2034
Mixed vetch	2691	1895	1708	2459	1387	2028

[1] Ammonium nitrate applied at the rate of 40 pounds of nitrogen per acre.

iod of time. This has not been determined by legume comparisons with higher nitrogen levels. Austrian winter peas are satisfactory but should not be grown more than 2 or 3 years consecutively on the same land because of disease problems. Willamette vetch and California bur clover generally have given good results but are somewhat susceptible to cold weather. As a result, there have been

Table 12.—Rates and dates of seeding winter legumes in the Yazoo-Mississippi Delta

Legume	Rate per acre	Date
Giant bur clover	10-15 bushels, unhulled	Last of July or 1st of August
Wild winter peas	50-60 pounds	August and September
Hairy vetch	30 pounds	September 15—October 15
Austrian winter peas	45-50 pounds	September 15—October 15
Willamette vetch	35-40 pounds	September 15—October 15
California bur clover	10-15 pounds of cleaned seed	August 15—September 15

Table 13.—The influence of rates of nitrogen on the yield of cotton Delta Branch Experiment Station, 1921-1949

Year	Pounds of nitrogen per acre[1]						
	No nitrogen	7.5 lbs.	15.0 lbs.	22.5 lbs.	30.0 lbs.	37:5 lbs:	45:0 lbs:
	Yields in pounds of seed cotton per acre						
1921	1384	1461	1562	1702	1723	1803	1705
1922	733	834	902	967	972	1008	1083
1923	457	622	768	879	991	958	874
1924	1168	1190	1198	1309	1369	1470	1456
1925	2604	3060	2965	3020	2903	3010	3050
1926	2074	2216	2362	2554	2863	3112	3102
1927	1315	1503	1657	1927	2704	2780	2790
1928	1628	1838	1959	2023	2201	2313	2390
1929	1382	1543	1663	1820	2038	2127	2257
1930	801	853	893	1115	1113	1136	1149
1931	1189	1326	1410	1444	1411	1556	1542
1932	645	711	828	889	963	1012	1052
1933	886	973	1091	1235	1493	1542	1656
1934	778	854	939	964	1012	1036	1075
1935	1048	1179	1207	1370	1434	1599	1651
1936	777	840	999	1082	1169	1085	1121
1937	902	1106	1257	1452	1620	1765	1798
1938	1167	1275	1417	1681	1781	1931	1999
1939	961	1036	1210	1244	1556	1545	1540
1940	949	1080	1252	1444	1549	1575	1586
1941	1104	1220	1435	1654	1875	2079	2236
1942	886	956	1198	1455	1487	1581	1794
1943	945	1045	1127	1247	1357	1421	1456
1944	836	923	1061	1284	1498	1437	1508
1945	654	869	1060	1424	1539	1763	1753
1946	736	817	1065	1116	1160	1331	1508
1947	903	1313	1168	1285	1577	1674	1868
1948	866	981	1163	1436	1610	1880	1917
1949	874	965	1134	1243	1419	1515	1585
Av. 1st 9 yrs.	1416	1585	1671	1800	1973	2065	2079
Av. 2nd 9 yrs.	910	1013	1115	1248	1333	1407	1449
Av. 3rd 9 yrs.	886	1029	1175	1350	1511	1601	1694
Av. 29 yrs.	1057	1192	1308	1457	1599	1691	1740
Increase over no nitrogen	—	135	251	400	542	634	683

[1] Nitrate of soda used as the source of nitrogen.

Table 8.—Yields of seed cotton in pounds per acre following different winter cover crops with com

Treatment	Yields							
	1933	1934	1935	1936	1937	1938	Average 1933-38	1939
No treatment	1262	982	1267	843	1106	767	1036	941
Rye	1147	873	1041	663	895	728	891	743
Nitrate of soda [1]	1759	1363	1532	962	1535	1031	1364	1519
Austrian winter peas	1791	1751	1917	1126	1610	994	1532	1430
Wild winter peas[2]	----	----	---	---	—	----	---	—
Hairy vetch	1782	1811	2271	1274	1913	1159	1702	2038
Melilotus indica	1441	1311	1703	1073	1763	1157	1408	---
Giant bur clover[3]	---	----	---	---	—	----	----	1651
California bur clover	1355	1385	1996	1142	1488	1275	1440	1978

[1] Sodium nitrate applied at the rate of 30 pounds of nitrogen per acre until 1948; increased to 45 pc

[2] Wild winter peas substituted for Austrian winter peas in the fall of 1946.

[3] Giant bur clover substituted for melilotus indica in the fall of 1938.

some complete failures with these legumes.

If results from winter legumes comparable to those cited herein are to be had, rates of seeding and dates of seeding should be considered. A compilation of seeding rates and dates is given in table 12. These recommendations are based on tests and observations. It is also essential that all cover crop seed except bur clover be well covered at the time of seeding.

From a research standpoint, the effect of the source of nitrogen on yield, growth, maturity of cotton, or on the soil itself, merits most of the attention. From a practical standpoint, however, other factors must be considered in the choice between winter legumes and commercial nitrogen. The cost of winter legumes as compared with commercial nitrogen is quite important. As a basis for comparisons, ammonium nitrate and wild winter peas have been selected. If 60 pounds of commercial nitrogen per acre were applied as ammonium nitrate, the cost, using 1949 fall prices, would be about $7.20 per acre, including the cost of application. The seed for wild winter peas for an acre would cost about $6.50. The cost of seeding and turning under peas would boost the cost to about $9 per acre. PMA payments would cover a major portion of the seed costs, thus the total cash out-lay would favor winter legumes. Without PMA payments, commercial nitrogen would be cheaper.

To summarize winter legume considerations, based on tests and observations, these are the factors that are important to the farmer:

Factors favoring winter legumes.—

(1) Turning under a good crop of winter legumes increases the yield of cotton equivalent to 40 to 60 pounds of commercial nitrogen.

(2) Price advantage under PMA program.

(3) Possible price advantage if farmer grows own seed.

(4) On soils, particularly silty clay loam and silty clays, where physical condition is a limiting factor, there appears to be temporary improvement of the physical condition that is particularly beneficial following winter legumes.

(5) There is normally a greater amount of nitrogen carried over to the next season following legumes than where commercial nitrogen is applied.

Factors opposed to winter legumes.—

(1) Cost without PMA payments.

(2) In more than 50 percent of the cases, poor stands prevail and total green weight turned under is very low.

(3) Two to 3 weeks must be allowed

parisons with commercial nitrogen and no treatment, Delta Branch Experiment Station, 1933-1949

pounds of seed cotton per acre

1940	1941	1942	1943	1944	1945	1946	Average 1939-46	1947	1948	1949
923	1168	1174	1192	1241	833	781	1032	1000	1223	1192
880	1169	1010	958	1086	761	742	919	750	1256	1153
1508	1857	1776	1712	1961	1465	1131	1616	1342	1836	1844
1361	1608	1422	1472	1497	1046	1224	1388	----	----	----
----	----	----	----	----	----	----	----	1906	1758	1927
1716	2231	2299	2195	2266	1361	1358	1933	1946	1788	2029
----	----	----	----	----	----	----	----	----	----	----
1613	2247	2440	2094	2250	1558	1355	1901	1962	1879	2150
1745	2310	2361	2002	2161	1762	1278	1950	1887	1754	2240

s of nitrogen per acre in 1948.

after turning under legumes before planting cotton; otherwise poor stands of cotton will result. With unfavorable weather, this time lapse may seriously delay the planting of cotton.

(4) If heavy growth is produced, turning under is a problem.

(5) Cutworm and other insect damage to young cotton is usually worse following winter legumes than where legumes were not grown.

(6) If there are deficiencies of phosphate, potash, or lime, these plant foods must be added for successful growth of winter legumes. Whether the efficiency of these minerals, applied to winter legumes, is as efficient as that applied directly for cotton is doubtful.

(7) Growing vetch, wild winter peas, or bur clover creates a serious weed problem if small grain is to be grown on the same land in the near future.

Summer Legumes for Cotton Production.—On many of the soils in the Delta, the physical condition is a limiting factor in production. With the return to cotton acreage control, there may be some advantages for turning under summer legumes on land that would otherwise be idle. Soybeans are the best legume for this purpose. Tests have shown that cotton following soybeans, turned under green, yielded more than where cotton followed winter legumes. The use of soybeans will also permit early land preparation, which is especially desirable on heavier soils.

Although there is no question as to the beneficial effect derived from soybeans turned under preceding cotton. there is considerable doubt whether such a practice is economical if the land can be put to another use. A rotation that would include pastures seems to have the greatest possibilities. This will afford some returns from the land at the same time that the condition of the soil is being improved.

Rates of Nitrogen

Adjusting the rate of application of nitrogen to provide the optimum amount for cotton offers a greater opportunity for higher and more economical yields than any other single controllable soil fertility factor.

Too little nitrogen results in yellow. stunted, low-yielding plants. Too much nitrogen results in excessive vegetative growth, delayed maturity, increased picking difficulty, and reduced yields. Research efforts have been directed toward ascertaining the optimum amount for maximum yields without the accompanying difficulties associated with excessive nitrogen.

Need for information related to rates of application was recognized early in the Delta, and consequently an experiment was initiated in 1921 to study the effects of rates of nitrogen ranging from no treatment to 45 pounds per acre in 7-½-pound increments. Nitrate of soda has been the source of nitrogen. It has been applied in the middle buster furrow prior to planting and the land rebedded. The 29-year results of this experiment are shown in table 13.

The yield of cotton has increased as the rates of nitrogen increased. The efficiency of nitrogen at different levels is indicated by the following figures, showing the increase in yield of seed cotton over the preceding increment:

	Pounds of seed cotton increase over preceding increment	Pounds of seed cotton per lb. of nitrogen
1st 7-½-lb. increment	135	18.0
2d 7-½-lb. increment	126	16.7
3d 7-½-lb. increment	149	17.8
4th 7-½-lb. increment	142	18.1
5th 7-½-lb. increment	92	16.9
6th 7-½-lb. increment	49	15.2

At the higher levels, increased yield per pound of nitrogen is slightly less. However, the increase is still profitable.

There have been no sharp declines in yields in the experiment due to length of the test except during the early years on untreated and low level nitrogen plots. There have been wide variations from year to year in yields due to seasonal variations.

Since the highest rate of nitrogen applied in the old experiment produced the highest yields, need for further study of the effect of higher rates of nitrogen was indicated.

In 1942 Kuykendall reported results of rates of nitrogen from three sources on a buckshot soil. Rates ranged from no nitrogen to 50 pounds of nitrogen per acre in 10-pound increments. The average yield of three sources of nitrogen showed that highest increases in yield were obtained when 50 pounds of nitrogen were applied. In a similar experiment on a shallow loam soil 5-year results show highest yields were also obtained by applying 50 pounds of nitrogen. In these tests, increasing the rate of nitrogen from 40 to 50 pounds per acre produced greater yield increases on buckshot soil than on the shallow loam soil.

Following through with the indicated need for further information pertaining to the effect of higher rates of nitrogen on the yield of cotton, the sources and rates of nitrogen experiments described earlier were set up so that each source of nitrogen could be compared at three rates. Table 14 lists yield increases from varying rates of nitrogen with the sources averaged. Average yields show an increase in yield of seed cotton as the rate of nitrogen increased. Application of 60 pounds of nitrogen produced the highest increase in yield. There were no interactions between rate of nitrogen and sources.

Table 15 shows the effect of varying rates of nitrogen on yield of cotton in four NPK tests. These tests were set up

Table 16.—Effect of varying rates of nitrogen on the yield of cotton on different soil types

Pounds of nitrogen per acre[1]	Sharkey clay		Bosket fine sandy loam	Forestdale silt loam		Crenshaw silt loam
	1947	1948	1947	1946	1947	1948
0	1038	1220	958	580	573	1375
20	1172	1668	1371	744	528	1628
40	1280	2015	1567	634	546	1873
60	1512	2394	1761	677	522	1991

[1] Each rate of nitrogen represents an average of four combinations with phosphate and potash.

Table 2.—Influences of sources of commercial nitrogen on yield of cotton at various locations in the Yazoo-Mississippi Delta

Treatment[1]	Yazoo City 1935-1944		Valley Hill 1935-1941		Charleston 1936-1940		Valley 1935-1939		Stoneville 1938-1942		Webb 1936-1939		Average increase over no nitrogen
	Yield[2]	Increase	Yield	Increase	Yield	Increase	Yield	Increase	Yield	Increase	Yield	Increase	
No nitrogen	1271	----	901	----	1161	----	808	----	1465	----	882	—	—
Nitrate of soda	1839	568	1221	320	1598	437	1214	405	1673	208	1434	552	415
Ammonium nitrate	1789	518	1205	304	1560	399	1177	368	1711	246	1325	444	380
Ammonium sulphate	1734	463	1116	215	1567	406	1199	390	1722	257	1362	480	369
Cyanamid	1694	423	1114	213	1538	378	1123	314	1717	318	1389	507	359
Uramon	1740	469	1202	301	1572	411	1138	329	1729	264	1227	345	353
Cal-nitro	----	----	1164	262	1627	467	1127	318	1739	274	1320	438	352
Calcium nitrate	----	----	1188	287	1553	392	1129	320	1703	237	1295	413	330

[1] All materials applied at the rate of 30 pounds of nitrogen per acre.

[2] Yields reported in pounds of seed cotton per acre.

Table 14.—Increased yield of seed cotton resulting from three rates of nitrogen at four locations in the Yazoo-Mississippi Delta in sources and rates of nitrogen tests

Pounds of nitrogen per acre[1]	Pounds of seed cotton per acre increase over untreated plots															
	Onward		Money				Stoneville					Yazoo City				
	1947	1948	1945	1946	1947	1948	1945	1946	1947	1948	1949	1946	1947	1948	1949	Average
30	436	786	165	162	408	302	176	460	350	439	305	232	304	324	590	363
45	651	975	206	191	471	352	331	601	453	530	484	247	371	461	765	473
60	787	1196	335	307	592	459	364	649	617	611	602	229	543	623	886	587

[1] Each rate represents an average of five sources.

Table 15.—Effect of rates of nitrogen on yield of seed cotton at various locations in the Yazoo-Mississippi Delta in nitrogen, phosphorus, and potash tests

Pounds of nitrogen per acre[1]	Pounds of seed cotton per acre															
	Stoneville						Yazoo City				Money				Onward	
	1944	1945	1946	1947	1948	1949	1945	1946	1947	1948	1945	1946	1947	1948	1948	Average
30	1585	2079	1594	1776	2044	1565	1770	1646	2132	1975	2054	1796	1717	2001	1842	1838
45	1746	2283	1867	1852	2285	1769	1735	1682	2213	2177	2177	1791	1897	2146	2030	1971
60	1962	2624	2138	2144	2608	2032	1605	1711	2358	2215	2129	1894	1939	2184	2256	2119

[1] Each rate represents an average of six treatments with varying rates of phosphate and potash.

with varying rates of nitrogen, phosphate, and potash. In the results listed, the phosphate and potash treatments were averaged. These data show increased yields from increased nitrogen comparable with table 14. The highest yields were produced by 60 pounds of nitrogen. There were no interactions between rates of nitrogen and phosphate or potash.

The effect of varying rates of nitrogen on cotton on different soil types is shown in table 16. Since these experiments could not be continued for a longer period, they cannot be used for definite conclusions. On the Sharkey Clay soil there was a bigger increase in yield between 40 and 60 pounds of nitrogen than on the other soils. No beneficial effect resulted from nitrogen on the Forestdale soil. In addition to poor internal drainage, typical of this soil, poor surface drainage was also a problem.

In 1945 a test was begun to study the effect of rates of nitrogen, up to 120 pounds per acre, on the yield of cotton at Stoneville. The 4-year results are listed in table 17. The 4-year average shows highest yields were produced by 60 pounds of nitrogen per acre. In 1947, relatively dry weather prevailed, which might account for increased yields of cotton from the higher rates of nitrogen. During other years, higher rates of nitrogen promoted excessive vegetative growth and delayed maturity, thus resulting in reduced yields. The experiment was continued through 1949; but due to the effect of wilt, data obtained that year have little value. As a point of interest, in 1949 wilt increased as the rate of nitrogen increased.

Table 18.—Increased yields of seed cotton from varying rates of anhydrous ammonia

Pounds of nitrogen per acre	Pounds of seed cotton per acre increase over untreated plots		
	1947	1948	Average
30	655	573	614
45	772	679	726
60	894	942	918
75	767	851	809

In one other experiment at Stoneville, started in 1948, anhydrous ammonia was applied at the rate of 30, 45, 60, and 75 pounds of nitrogen per acre as preplanting, side dressing, and split applications. The effect of the rates with the time of application averaged is shown in table 18. In this test maximum yields have been produced by 60 pounds of nitrogen. Application of 75 pounds of nitrogen per acre resulted in yields slightly lower than those produced with 60 pounds.

The effect of rates of nitrogen on the maturity of cotton is becoming increasingly important because of the trend toward mechanical harvesting of cotton. Table 19 shows the effect of rates of nitrogen on the percent of cotton open at the first picking in the test reported in table 13. There has been only one picking made in several of the seasons, which accounts for the missing years. These data show that at all levels application of nitrogen increased the percentage of cotton open at the first pick-

Table 17.—Effect of six rates of nitrogen on the yield of cotton, Delta Branch Experiment Station, 1945-48

Pounds of nitrogen per acre	Pounds of seed cotton per acre				
	1945	1946	1947	1948	Average
20	2235	1820	1980	2326	2090
40	2257	1964	2278	2513	2253
60	2300	2119	2357	2572	2337
80	2270	2244	2385	2222	2280
100	2200	2076	2484	2239	2250
120	2064	2073	2575	2283	2249

ing as compared with untreated plots. There have been only small differences between the rates. Application of 30 pounds of nitrogen accounted for the highest percentage of the cotton open at the first picking. However, application of 45 pounds resulted in the largest amount of cotton by weight at the first picking.

Adequate data are not available to show the effect of higher rates of nitrogen on the maturity of cotton. In the sources and rates of nitrogen experiments, described earlier, the application of 60 pounds of nitrogen resulted in about the same amount of cotton open at the first picking as where 45 pounds had been applied. The percentage of the total yield open at the first picking was higher where 45 pounds of nitrogen were applied than when 60 pounds were applied.

In the experiments that have been conducted where rates of nitrogen for cotton production were compared, the yields have been the main consideration. However, in the final analysis, increased yields are only important insofar as they increase the net returns to the farmer. At the present price levels, there is a very close relationship between increased yields from fertilizer and net returns. When all of the data comparing rates of nitrogen are considered, the results reported in table 14 appear to be a fair example of what can be expected in terms of increased yields from different levels of nitrogen. Using those figures as a basis, table 20 illustrates the net returns for nitrogen. The above figures show that as yields have been increased due to nitrogen, there has been a comparable increase in profits. Increasing the rate of nitrogen from 45 to 60 pounds per acre shows a net gain of $6.88 per acre. Use of anhydrous ammonia as the source of nitrogen and mechanical harvesting would further reduce costs, thus increasing net profits.

When To Apply Commercial Nitrogen

Application of nitrogen at a time that will assure maximum returns is of primary importance. The possibility of spreading out the period of applying nitrogen without seriously affecting yield also deserves consideration. This is particularly important to the farmer because of varying weather conditions and critical

Table 19.—Effect of rates of nitrogen on percent of cotton open at first picking, Delta Branch Experiment Station

Pounds of nitrogen per acre	Percent of cotton open at first picking										
	1934	1938	1939	1940	1941	1943	1944	1945	1947	1949	Aver.
No nitrogen	74.8	53.6	17.7	42.4	51.9	86.7	75.2	32.7	60.0	55.1	55.6
7.5	79.0	54.0	28.1	47.1	54.3	92.9	83.4	48.5	71.1	67.6	62.6
15.0	77.9	54.1	31.3	46.6	57.3	93.2	84.6	57.1	71.1	69.1	64.2
22.5	73.3	59.0	34.0	43.7	58.4	93.0	83.2	58.0	72.5	69.5	64.6
30.0	69.9	54.0	51.3	40.8	58.3	93.5	79.6	67.5	70.8	65.7	65.1
37.5	71.8	52.8	50.9	38.0	53.8	91.8	83.9	60.1	68.1	58.0	62.9
45.0	71.8	45.2	53.6	37.2	52.2	92.1	84.3	63.6	73.5	61.4	63.4

Table 20.—Net returns per acre from three levels of nitrogen applied to cotton

Pounds of nitrogen per acre	Increased yields in pounds of seed cotton per acre	Increased gross[1] returns	Increased costs[2]	Profit per acre from nitrogen
30	363	$41.23	$17.37	$23.86
45	473	53.93	23.13	30.80
60	587	66.71	29.03	37.68

[1] Lint figured at 30c per pound and seed at $45 per ton.

[2] Costs are figured as follows: Picking, weighing, and hauling, $3 per hundred; ginning at 60c per hundred; and nitrogen at 12c per pound and cost of applying at 70c per acre.

periods in the use of farm equipment. Several tests have been conducted by the Delta Branch Experiment Station to study these problems.

Results of 9 years' work at the Delta Station, which compared calcium nitrate and cyanamid applied at 2-week intervals, from February 1 to May 1, showed little difference as a result of varying the time of application. The highest average yields were obtained from March 1 application. Differences were so small that it could be concluded that an application of nitrogen any time between February 1 and planting time was satisfactory in this experiment.

Since there were only slight differences in yields due to varying the time of application from February 1 to May 1, an experiment was begun in the fall of 1936 to compare fall application of three sources of nitrogen with the same three sources applied in the spring. Nitrate of soda, ammonium sulphate, and cyanamid have been used as the nitrogen sources and applied at the rate of 30 pounds of nitrogen per acre. The 13-year results of this test are reported in table 21.

Yields from spring application have been slightly higher than those obtained from fall-applied nitrogen. It should be pointed out that there is a heavy subsoil layer about 18 to 24 inches below the surface which might retard leaching of the fall-applied materials; otherwise the differences might have been greater. Therefore these results may not be applicable to all sandy loam soils.

In another experiment conducted at Stoneville in 1949 anhydrous ammonia applied in December was almost as satisfactory as that applied in May in terms of yield. However, early growth of grass and weeds was much more vigorous where ammonia was applied in the fall than where spring application was made. As a result, it is reasonable to believe that had cultivation and hoeing been delayed, lower yields would have resulted where the nitrogen was applied in December than where the ammonia was applied in the spring. In the same test the application of ammonia in July resulted in lower yields than December, May, or June applications. These are 1-year results and cannot be used for drawing definite conclusions.

Table 21.—Fall versus spring application of nitrogen for cotton, Delta Branch Experiment Station, 1937-49

Treatment	Pounds of seed cotton per acre														Increase over nitrogen
	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	13-yr. average	
No nitrogen	935	1176	1045	830	1233	987	877	910	845	641	1045	1023	678	940	—
Sodium nitrate—Fall	1531	1630	1341	1376	2045	1321	1189	1729	1514	1278	1647	1562	1287	1496	556
Sodium nitrate—Spring	1628	1722	1313	1371	1984	1305	1277	1517	1753	1285	1541	1772	1328	1522	582
Ammonium sulphate — Fall	1469	1585	1439	1331	2038	1524	1174	1715	1477	1325	1625	1568	1253	1502	562
Ammonium sulphate—Spring	1636	1658	1470	1321	2098	1553	1313	1387	1552	1248	1761	1696	1265	1535	595
Cyanamid — Fall	1493	1648	1470	1357	1931	1493	1337	1572	1420	1369	1479	1565	1221	1489	549
Cyanamid—Spring	1659	1802	1387	1400	2128	1543	1368	1418	1651	1405	1769	1653	1305	1576	554

Whether it is more effective to apply nitrogen before planting, as a side dressing, or by splitting the application has also been studied in several tests. The 16-year average of one test shows that there was little difference resulting from the different times of application of nitrogen Splitting the nitrogen application produced slightly higher yields, but it is doubtful that they were significantly higher.

In a test begun in 1948, preplanting application of anhydrous ammonia at four levels has been compared with side-dressing application and split application at similar rates. The 2-year results with rates averaged are listed in table 22. Although yields are slightly higher where all the anhydrous ammonia was applied before planting, the yields are not significantly different from the split application. Side dressing with anhydrous ammonia produced less increase in yield than the other two methods.

Summarizing the results of the time of application studies, fall-applied nitrogen has been almost as satisfactory as spring-applied nitrogen when yields alone are considered. Varying the time of applying nitrogen in the spring has not affected yields significantly. Preplanting and split applications of anhydrous ammonia have given better results than side dressing applications.

It should be pointed out that despite the small differences arising from varying the time of application in the tests described, it is reasonable to believe that these results will vary with weather conditions and soil types. On the sandier soils without a heavy subsoil, more leaching will probably occur, particularly during periods of excessive rains. This may make it desirable to apply nitrogen nearer planting time. A split application may even be profitable. There have been some observations to indicate this. Also, where leaching is a factor, the ammonia forms of nitrogen should show an advantage over the nitrate forms.

Table 22.—Increase in yield of cotton as affected by the time of applicaticn of anhydrous ammonia, Delta Branch Experiment Station, 1948-49

Time of application[1]	Pounds of seed cotton increase over untreated plots		
	1948	1949	2-year average
Before planting	858	872	862
½ before planting and ½ as a side dressing	803	760	781
Side dressing	654	653	654

[1] Each time of application represents an average of rates of 30, 45, 60, and 75 pounds of nitrogen per acre.

It is also recognized that under many conditions it may not be possible to apply nitrogen before planting. In that case, side-dressing application should be made as early as possible, preferably immediately after cotton is cleaned out for the first time. Moisture must be available for utilization of the applied nitrogen. Therefore, a delay in side dressing reduces the chances of the cotton plant to make the most efficient use of the nitrogen. Late side dressing will also result in delayed maturity.

Placement of Nitrogen

The effectiveness of different methods of nitrogen placement will depend on several factors, including type of soil, kind of nitrogen material, amount and distribution of rainfall, and the time of application.

Results of an 8-year study at Stoneville of different placement methods of calcium nitrate and cyanamid showed that differences due to placement were small. Calcium nitrate produced highest yields when it was applied in the drill and bedded upon. Cyanamid was as effective when broadcast as when applied in bands.

In 1945 an experiment was started to study the effect of nitrogen on the yield of cotton when applied at two depths and at six rates, ranging from 20 to 120 pounds per acre. In this test nitrogen applied in the middle buster furrow and the beds rebedded was compared with nitrogen applied about 10 inches deep. The 4-year results with the rates averaged are shown below:

Treatment	Pounds of seed cotton per acre				
	1945	1946	1947	1948	Av.
Applied in middle buster furrow	2242	2029	2323	2286	2220
Applied 10 inches deep	2185	2069	2363	2431	2262

The average yields show a slight but not significant advantage for the deeper placement. There was no interaction between rates and depth of application.

Placement of nitrogen has assumed new importance in recent years because of the rapid spread of the use of anhydrous ammonia. With solid fertilizers, benefits that might accrue from placement cannot be realized by the farmer because of limitations in the equipment for applying it. Anhydrous ammonia, however, can be placed wherever desired without too much difficulty, provided the soil is in a fair state of tilth. With this is mind, studies were initiated in 1948 to study depth of placing anhydrous ammonia and to study the effect of varying the distance from the seed drill. The development of a satisfactory experimental fertilizer distributor for applying solid materials permitted the expansion of the experiment to include ammonium nitrate in 1949.

Table 23.—Increases in yield of seed cotton in pounds per acre of anhydrous ammonia and ammonium nitrate when applied at varying depths at the rate of 60 pounds of nitrogen per acre

Depth of placement	Anhydrous ammonia		Ammonium nitrate
	1948	1949	1949
4 inches	835	633	664
6 inches	790	722	746
8 inches	832	891	870
10 inches	710	874	872

Table 24.—Increase in yield of seed cotton in pounds per acre from anhydrous ammonia and ammonium nitrate when applied at varying distances from the drill at the rate of 60 pounds of nitrogen per acre

Placement	Anhydrous ammonia		Ammonium nitrate
	1948	1949	1949
Directly beneath the seed drill	754	636	677
6 inches to one side of seed drill	737	633	689
In two band 6 inches from seed drill on each side	731	678	654
13 inches from seed drill	811	657	609
20 inches from drill	891	683	624

In the depth of placement tests, materials were applied before planting in the center of the beds at the rate of 60 pounds of nitrogen per acre. The 2-year results are shown in table 23.

In 1948 varying the depth of placing anhydrous ammonia did not affect the yield significantly. In 1949 anhydrous ammonia and ammonium nitrate were significantly better when applied 8 or 10 inches deep than when applied 4 inches deep. There were no observable differences in the rate at which the cotton grew off or in the grass and weed growth as a result of varying depths of placement.

In the other placement test, with special reference to distance from the drill, the nitrogen materials were applied 6 inches deep before planting at the rate of 60 pounds of nitrogen per acre. The results are listed in table 24. These data show no significant differences as a result of varying the distances of the application from the drill. Neither was there any observable difference in the rate of the early growth of cotton.

Similar tests have been conducted where the nitrogen was applied as a side dressing. In these tests no significant differences have resulted from varying the distance from the drill.

It should be pointed out that results obtained in these tests may not be applicable to all conditions, particularly to soils of low fertility. Apparently the soil on which these tests were located contained enough nitrogen to supply the needs of the cotton plants until sufficient root development had occurred to permit utilization of nitrogen placed further away. Where the nitrogen level is low, it is reasonable to believe that nitrogen applied nearer the drill will be utilized sooner than if placed several inches from the drill, thus resulting in more rapid early growth.

Recently there have been two experiments conducted which compared band application with broadcast application of solid materials. The results have not been consistent. However, there were indications that yields were slightly higher with band placement than with broadcast application. There are two objections to broadcast application of nitrogen materials: (1) When nitrogen is applied broadcast, grass and weeds have a better chance to reach the nitrogen; and (2) initially, the nitrogen will be concentrated in the first inch of soil, which will increase the susceptibility to loss by sheet erosion.

Phosphate, Potash, and Lime

The soils of the Yazoo-Mississippi Delta have been formed from sediments from the Mississippi River and its tributaries. Each tributary of any consequence has exercised a certain amount of influ-

Table 25.—Average yields of cotton showing influence of phosphate and potash with nitrogen rates of 30, 45, and 60 pounds per acre averaged

Treatment	Pounds of seed cotton per acre				
	Stoneville[1] 1945-49	Yazoo City[2] 1946-48	Money [3] 1945-48	Onward[4] 1948	Money[5] 1948
No P_2O_5	2060	1853	1889	2084	1905
20 pounds P_2O_5 per acre	2024	1926	----	2021	1906
40 pounds P_2O_5 per acre	2044	1937	1911	2024	1952
No K_2O	2020	1882	1842	2056	1968
20 pounds K_2O per acre	2066	1928	1899	----	----
40 pounds K_2O per acre	----	----	1959	2030	1873

[1] Stoneville test located on a well drained, fine sandy loam, low terrace soil.

[2] Yazoo City test located in a well drained, fine sandy loam, low terrace soil.

[3] This test at Money is located on a low terrace soil ranging from a silty clay loam with fair drained to well drained sandy loam soil.

[4] Onward test located on a well drained, fine sandy loam, low terrace soil.

[5] This test at Money located on a silty clay loam, low terrace soil with fair internal drainage.

Table 26.—Yields of cotton showing the influence of phosphate and potash with nitrogen rates of 20, 40, and 60 pounds per acre averaged

Treatment	Pounds of seed cotton per acre			
	Roundaway[1] 1947-48	Tutwiler[2] 1947	Tutwiler[3] 1947	Valley Hill[4] 1948
No phosphate	1478	1389	640	1735
40 pounds P_2O_5 per acre	1596	1439	678	1708
No potash	1526	1373	622	1593
40 pounds K_2O per acre	1549	1455	695	1851

[1] Test located on low bottom, clay soil with poor internal drainage.

[2] Test located on fine sandy loam, low terrace soil with very good internal drainage.

[3] Test located on silty clay loam, low terrace soil with poor internal drainage.

[4] Test located on silt loam, first bottom soil with good internal drainage.

ence on the soils formed nearby. With a large number of streams entering the Delta from the hills and many old stream beds slicing through the alluvial area, widely divergent soil conditions have developed. The soils vary greatly in their physical characteristics, their management requirements, and in their capacity to produce crops. Similarly, there are wide variations in the levels of available plant food. These facts are known. Undetermined, however, is the ability of the different soils to release a continual supply of available plant food, other than nitrogen, through natural soil processes. With these considerations in mind, the possibility of developing information to use as a basis for Delta-wide recommendations concerning the use of phosphate, potash, and lime appears doubtful. Recommendations by areas or soil types seem to have more possibilities.

There have been several experiments conducted to study the effect of varying rates of phosphate and potash on the yield of cotton. Tests have also been made with the phosphate and potash applied where winter legumes were turned under preceding cotton. Results of a few of these tests showed no response to phosphate and potash at Stoneville, a slight response to potash at Yazoo City, and an indication of benefit from phosphate and potash at Money.

In more recent experiments, summaries of which are given in tables 25 and 26, no response to phosphate and potash was found at Stoneville, Onward, in two tests at Money, or in two tests at Tutwiler. On a first bottom silt loam soil at Valley Hill, potash was very beneficial. At Yazoo City, although there are only small differences in the average yields, potash produced significant increases in yields in 1948. On the Sharkey clay soil at Roundaway, a small but significant increase in yield has resulted from the application of phosphate.

In the fall of 1945 lime was applied on one-half of each plot in the NPK tests at Stoneville, Yazoo City, and Money. No beneficial effect was indicated.

Results of the experiments conducted thus far would justify no general recommendations for the use of any plant food other than nitrogen. The tests that have been conducted point up the need for further testing with special reference to soil types.

Sources of Nitrogen.—When all tests are considered, there have been only small differences in the increased yields of cotton resulting from anhydrous ammonia, ammonium nitrate, nitrate of soda, cyanamid, or ammonium sulphate.

In the experiments conducted in the eastern part of the Delta, where the soils are influenced by streams from the hills, nitrate of soda has produced slightly higher yields per pound of nitrogen than other sources of nitrogen.

If cyanamid is applied too near planting time without rain intervening, it may be toxic to young cotton plants, thus delaying growth and resulting in lower nitrogen efficiency than is true with other materials.

Anhydrous ammonia is the cheapest source of nitrogen. Ammonium nitrate is the cheapest nitrogenous material in solid form, and nitrate of soda is the most expensive.

Anhydrous ammonia may be applied more accurately than solids and affords more flexibility in placement. However, on clay soils the application of anhydrous ammonia is difficult due to the problem of sealing it in the soil. It is necessary that sufficient loose soil be present to assure immediate covering.

A good growth of winter legumes turned under preceding a cotton crop has increased yields equivalent to 40 to 60 pounds of commercial nitrogen.

Hairy vetch, wild winter peas, and giant bur clover have given the best results of the legumes tested. Both the advantages and disadvantages of winter legumes should be considered.

Rates of Nitrogen.—The yields of cotton have increased as the rates of nitrogen have increased up to 60 pounds of nitrogen per acre.

Greater increases in yield have resulted from increasing the nitrogen from 45 to 60 pounds per acre on clay soils than on sandy loam soils. This suggests that higher rates may be profitable on buckshot or clay soils.

In the tests conducted, nitrogen applied at rates above 60 pounds per acre have resulted in slightly lower yields than those produced by the 60-pound rate of nitrogen. This was not true on a dry year.

Profits from nitrogen have increased as yields have increased.

Time of Applying Nitrogen. — There has been little difference in yield as a result of varying time of application from February 1 to May 1.

There has been no significant difference between pre-planting application and split application of nitrogen.

Side dressing application of nitrogen has not been as satisfactory as pre-planting or split application.

Fall application of nitrogen has produced slightly lower yield increases than spring-applied nitrogen.

Placement of Nitrogen.—In the tests conducted, varying the placement has affected the yields very little.

There are indications that deeper placement (6 to 8 inches deep) may be beneficial.

Phosphate, Potash, and Lime.—The response to these plant foods has been confined to limited areas and vary with the soil conditions. No general recommendations concerning their use can be made.

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A Study of the Composition of Milk Produced In Different Areas of Mississippi

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A STUDY OF THE COMPOSITION OF MILK PRODUCED IN DIFFERENT AREAS OF MISSISSIPPI

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The composition of milk is important in determining its commercial and nutritive value and is a factor that must be considered when milk is processed into various products. It is, therefore, of direct interest to the milk producer, the consumer, and the milk plant operator.

The composition of milk, especially the portion represented by butterfat, is directly related to the price of milk and milk products. The practice of paying for milk on the basis of its butterfat content is the most common procedure in the industry. Variations in butterfat content not only reflect on the price structure of milk, but this constituent, together with the total solids and solids-not-fat portion, is considered in the legal definition of commercially acceptable milk.

Many states and municipalities have established by law a minimum standard for these components in milk. Mississippi, for example, requires that legal milk contain at least 3.0 percent butterfat, 8.5 percent solids-not-fat, and 11.75 percent total solids. Thus, both the producer and milk plant operator are aware of the commercial importance of the composition of milk and are interested in the variations that occur in this milk characteristic.

The constituents present in milk are also closely associated with the nutritive value of this food. They are, in no small way, responsible for the important position that milk retains in our present American diet. The many fatty acids that are combined in buterfat are a good source of energy and, according to recent research, consist in part of some highly unsaturated fatty acids that are essential in normal nutritional needs. Milk fat also functions as a carrier of vitamin A and D.

The proteins in milk, which are casein, lactoalbumin, and lactoglobulin, are composed of many amino acids, including all those that are essential to proper growth and development. Lactose, or milk sugar, provides energy, plays an important role in calcium assimilation, and creates a mildly acid reaction in the intestinal tract. Milk used in recommended quantities also contains calcium and phosphorus in ample amounts for the development of bone and tooth structure and maintenance, especially for children. There are other valuable constituents present in lesser amounts in milk.

Of equal significance is the part the composition of milk plays in the processing of milk into various products. In cheesemaking, for example, the amount of butterfat and casein in milk determines the degree of standardization practiced during various seasons of the year and establishes the amount of cheese secured from a given quantity of milk. The percentage of these constituents present in milk largely affects the yield in evaporated and condensed milk. The ratio of calcium to phosphates and citric acid in milk, more commonly referred to as the salt balance, affects the heat stability of evaporated milk, determines the rate of rennet action in cheesemaking, and influences the moisture content of the finished cheese.

Defects such as feathering in coffee cream and coagulation of milk used in cooking are, in part, related to this salt balance characteristic. Thus, the intelligent application of techniques in milk processing requires a knowledge of the composition of the milk and the variations that occur in these constituents from season to season.

Milk has been analyzed by many investigators in the northern and northeastern United States, Germany and England. On the basis of these studies, the fact that milk constituents are variable and are subject to the influence of several factors has been established. It has been shown, for example, that the breed of cattle, the type and quantity of feed consumed, the time interval between milkings, the prevailing temperature conditions, the period of lactation, the season of the year, and the individuality of the cow are some factors which influence the composition of milk produced.

Only a limited amount of information pertaining to the composition of southern produced milk is available. Herzer and others (4) at the Mississippi Experiment Station reported that butter produced in Mississippi had chemical and physical characteristics slightly different from northern butter. Fouts and Krienke (3) at the Florida Experiment Station in a preliminary study indicated that Florida milk had a composition within the range of reported analyses from northern and northeastern United States.

More information regarding the composition of milk produced in Mississippi and other southern states is desirable, especially since dairying is increasing in these regions. It is also recognized that a major quantity of Mississippi produced milk involves climatic conditions, breed differences, grazing periods, and types of herbages available for grazing that may vary from those of other established milk producing areas. Furthermore, Mississippi has many soil types which vary in their calcium, phosphorus, and potassium content.

In view of these factors, a study of the composition of milk produced under Mississippi conditions was undertaken. Three objectives were sought in this investigation; (1) to establish the composition of Mississippi produced milk, (2) to determine the seasonal trends in composition, and (3) to compare the composition of milk produced in the different soil areas of the State.

Experimental Procedure

A study was started in January 1948 and continued through May 1949. During this period, milk samples from Biloxi, Hattiesburg, Jackson, Leland, Olive Branch, Tupelo, Starkville, and State College, Mississippi, were analyzed each month. These areas were selected on the basis of soil type, the importance to dairying and the geographical cross-section of the State. A milk processing plant or receiving station in each area cooperated by taking representative samples of their local production once each month. Two samples of one-quart each were taken either by drip samples or from vats representing milk from many cows. One sample was preserved with formalin and the other was unpreserved. The samples were chilled, packed in an insulated container and shipped to the Dairy Manufacturing Department laboratories, where analyses were started immediately upon arrival.

The milk was analyzed for the following constituents and characteristics: butterfat, total solids, serum solids (total solids less butterfat), total protein, casein, albumin, protein in albumin filtrate, lactose, ash, phosphorus, calcium, potassium, sodium, magnesium, chloride, hydrogen ion concentration titratable acidity, lactometer reading and freezing point.

The butterfat was determined by the Babcock method. The total solids content was measured using a procedure approved by the Association of Official Agricultural Chemists and was frequently checked with the Mojonnier method. After obtaining the total solids data, the sample was ashed to whiteness at 550° C. from which the percent ash was determined. The ash was dissolved in dilute hydrochloric acid and made up to 250 ml and the resulting solution was used for phosphorus, calcium and magnesium determinations. Phosphorus was measured by alkali titration of ammonium phosphomolybdate precipitate, while calcium was determined by permanganate titration of calcium oxalate and magnesium by precipitating magnesium pyrophosphate. The results of the ash, calcium, magnesium, and phosphorus were expressed as percent ash, calcium oxide, magnesium oxide, and phosphorus pentoxide, respectively.

Both sodium and potassium were determined from 10 grams of milk using the perchloric acid procedure, a method tentatively approved by the Association of Official Agricultural Chemists. The results were recorded as percent sodium oxide and potassium oxide.

The chloride was analyzed by the Sander's titration method and was expressed as percent chloride.

Hydrogen ion measurements were made with a glass electrode potentiometer. The Hortvet cryoscope was used to secure freezing point values and the Quevenne lactometer was used for lactometer readings.

The determinations of total protein, casein, albumin and protein in albumin filtrate followed the Kjeldahl- Gunning-Arnold method. The factor 6.38 was used to convert nitrogen to protein. The results were expressed as percent total protein, casein, albumin, and protein in albumin filtrate.

Lactose was measured by the gravimetric method of the Association of Official Agricultural Chemists. Frequent checks using the polarimetric procedure were used. Only data from the gravimetric method, however, were recorded and expresed as percent lactose.

All determinations except gravimetric lactose, titratable acidity and freezing point were taken from the preserved milk sample.

The milk samples were adjusted to 15° C. and were thoroughly mixed before the analyses, and all determinations were made in duplicate.

Average Composition

The average composition of Mississippi produced milk, as shown in table 1, included the average of all analyses from June 1948 and each of the following months to and including May 1949. The results of analyses prior to June 1948 were not included in this table in order to avoid any overlapping of seasonal influence. Considering that each sample was analyzed in duplicate, the data on this table represents 180 determinations for each constituent. Since the analyses were equally distributed over a period of one year, the influence of the stage of lactation and season are fairly well proportioned. This table is also representative of the State of Mississippi, since the samples were secured from the northern, central, Delta, and Gulf Coast areas. Furthermore, these results represent the milk of many thousands of animals in these regions. Accordingly, the values shown in table 1 are regarded as a reliable average composition for Mississippi-produced milk.

Table 1. The average composition of milk produced in Mississippi.

Constituent	Percentage
Butterfat	4.72
Total solids	13.83
Serum solids	9.11
Total protein	3.56
Casein	2.71
Albumin	.40
Protein in albumin filtrate	.43
Lactose	4.70
Ash	.71
CaO	.181
P_2O_5	.243
MgO	.024
Na_2O	.072
K_2O	.148
Cl	.088

These results compare favorably with those reported by Sommer (8), which are as follows:

Butterfat	3.9%	Ash	.7%
Total solids	13.1%	CaO	.170%
Total protein	3.2%	P_2O_5	.195%
Casein	2.5%	MgO	.017%
Albumin & Globulin	.7%	Na_2O	.070%
Lactose	5.1%	K_2O	.175%
		Cl.	.100%

A comparison of these two analyses shows that Mississippi-produced milk contains a higher amount of butterfat, total solids, total protein, casein, calcium phosphorus, magnesium, and ash but less lactose, potassium and chloride than the compared milk composition. The sodium content appeared to be the same for both areas. Further comparison shows that some difference exists in the ratio of milk constituents from the two areas. For example, nearly 34.1 percent of the total solids in Mississippi milk is butterfat, while in the northern analyses, the butterfat represents slightly less than 30 percent of the total solids.

The serum solids in Mississippi milk contain 39 percent protein while the compared analysis shows 35 percent of the serum solids to be protein. Casein makes up 29.7 percent of the serum solids(total solids less butterfat) in Mississippi milk and 27.1 percent for northern milk. The lactose content, however, was lower in the milk studied representing 51.5 percent of the serum solids, while in the northern milk the serum solids contain 55.4 percent lactose. Mississippi-produced milk contains more phosphorus per unit of calcium than the compared analysis.

Undoubtedly, many factors are involved in the difference in milk composition and the ratio of milk constituents as discussed above, but it is very likely that breed predominance is a major contributory influence. This is considered possible because of the fact that Jersey and Guernsey breeds are rather common in Mississippi. It is general knowledge that these breeds produce milk with a higher fat percentage than Holsteins; however, it is also true that the Jersey and Guernsey breeds produce milk with higher amounts of other milk constituents than the Holstein. This is evident from data presented by Overman and others (6), showing the following average percentages for Holstein, Jersey and Guernsey breeds:

	Fat	Ttl. Solids	Protein	Lactose
Holstein	3.41	12.50	3.30	4.89
Jersey	5.05	14.69	3.79	5.00
Guernsey	5.03	14.87	3.89	4.97

There is also evidence that the mineral content varies according to the breed. Jacobsen and Wallis (5) reported that Jersey milk contains 25 percent more calcium and phosphorus than Holstein milk.

On the basis of the above data, it is clear that the results presented in table 1 are in agreement with other analyses involving Jersey and Guernsey breeds. One point of a lack of agreement, however, is in the lactose content. The report by Overman (6) shows a higher lactose content for the Channel Islands breeds than for Holsteins. The lactose content for Mississippi milk was found to be lower than the breeds considered in the data by Overman.

Generally, most information in the literature on milk composition shows lactose to be about 5.00 percent with little, if any, difference due to breed. Some of this information was secured not by a direct analysis of lactose but rather by subtracting the butterfat, protein and ash from total solids. The result attained is, presumably, lactose. It is possible that some error is introduced by the procedure and that the lactose content of all milk is not as high as 5.00 percent. Further evidence to substantiate this theory is the fact that an average relationship exists between lactose and the ash constituents in milk, which is reported in the following pages of this study. In other words, as the ash percentage increases the lactose content declines. On this basis and since the milk from Jersey and Guernsey breeds contains a high ash, it would seem likely that the same milk would be low in lactose. This study conforms to this analogy in that higher ash percentages and lower lactose levels were found than are generally recorded in literature.

Any objective interpretation of the nutritive value of Mississippi milk as far as the constituents listed in table 1 are concerned would conclude that the milk from this region compares favorably with that of other areas. The lesser amounts of lactose and potassium, in all probability, have no practical significance. It may be, however, that Mississippi milk tastes less sweet than northern milk due to the lower lactose content.

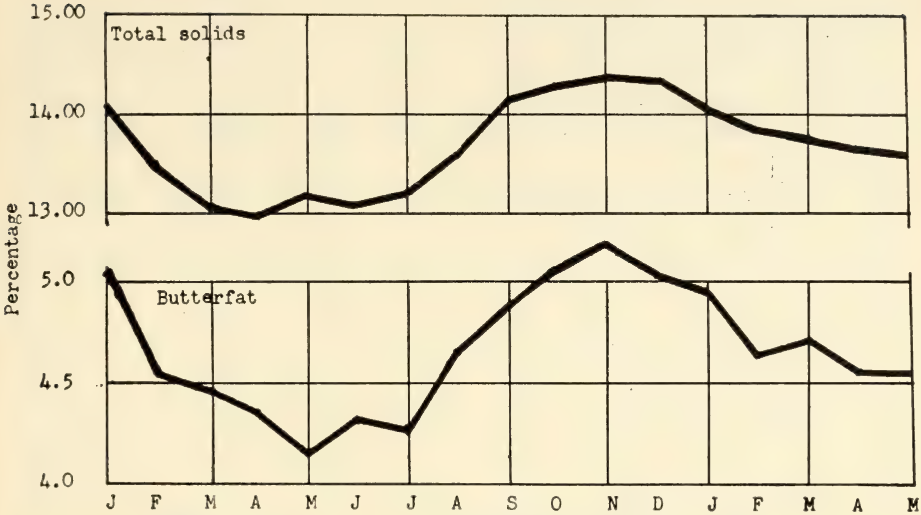

Figure 1. Seasonal trends of butterfat and total solids by months.

Greater yield in cheese manufacture and evaporated milk are possible from this higher solids milk than from a lower solids milk. Thus, a regional difference in these manufacturing characteristics is evident. Because of the higher fat to total solids ratio in Mississippi milk, a regional difference in the degree of fat standardization for cheesemaking becomes necessary.

Seasonal Trends in Composition

Results of this study show that season had an influence either directly or indirectly on many of the milk constituents. The month-to-month averages, as expressed in table 2, followed a definite trend throughout the seasons. Generally, the butterfat and total solids (see Figure 1) showed the most variation and were higher during the winter than during the summer. The maximum average for these components was observed during November at 5.2 percent and 14.42 percent, respectively. A low average of 4.2 percent for butterfat and 12.92 percent for total solids appeared during May. From March through July, the butterfat and total solids were low and from July through November, these constituents gradually increased in percentage. The trends showed a decrease from November through March. Although the butterfat curve generally followed the total solids variation, these two values did not vary in direct proportion.

A comparison of these results with those reported by Turner (9) and Jacobsen and Wallis (5) shows good agreement in that a higher fat and total solids prevailed in winter than in summer milk. However, a difference in the maximum average variation between the seasons is clearly evident. For example, Turner (9) shows a .59 percent maximum difference between the fat content of winter and summer milk from Jerseys, with less difference for the other breeds. Our data show a 1.0 percent difference in the fat content between winter and summer milk. No similar comparison of total solids values is available, but it is noteworthy that a 1.50 percent maximum difference between the total solids content of winter milk and summer milk is shown in table 2.

Some evidence of a difference in the time during which the minimum butterfat and total solids values develop is also apparent when Mississippi milk analyses

Table 2. The average composition of milk by calendar months.

Month	Butter fat pct.	Total solids pct.	Serum solids pct.	Total protein pct.	Casein pct.	Albumin pct.	Protein in albumin filtrate	Lactose pct.	Ash pct.	Phosphorus pct.	Calcium pct.	Potassium pct.	Sodium pct.	Magnesium pct.	Chloride pct.
January	5.07	14.12	9.05	3.60	2.65	.50			.74	.242	.201			.025	.084
February	4.56	13.43	8.87	3.34	2.55	.35			.70	.228	.183			.04	.088
March	4.45	13.05	8.60	3.37	2.60	.31	.47		.72	.245	.187	.163	.058	.043	.084
April	4.30	12.95	8.65	3.45	2.71	.38	.38	4.77	.71	.268	.171	.144	.078	.033	.086
May	4.21	13.24	9.03	3.53	2.73	.35	.42	4.88	.71	.275	.157	.143	.054	.036	.081
June	4.32	13.06	8.74	3.45	2.63	.44	.395	4.82	.71	.248	.169	.152	.071	.031	.087
July	4.27	13.23	8.96	3.37	2.61	.42	.405	4.73	.68	.239	.160	.164	.079	.022	.087
August	4.68	13.59	8.91	3.49	2.69	.39	.46	4.88	.69	.233	.171	.145	.069	.021	.088
September	4.82	14.16	9.34	3.72	2.82	.46	.49	4.79	.72	.242	.180	.135	.075	.035	.083
October	5.04	14.29	9.25	3.81	2.86	.43	.523	4.72	.70	.249	.187	.142	.072	.024	.098
November	5.20	14.42	9.22	3.83	2.89	.43	.48	4.63	.71	.243	.185	.136	.077	.039	.083
December	5.03	14.34	9.31	3.73	2.84	.46	.44	4.56	.72	.238	.195	.137	.077	.025	.084
January	4.91	14.05	9.14	3.64	2.76	.45	.39	4.57	.72	.241	.191	.147	.076	.019	.095
February	4.65	13.80	9.15	3.53	2.66	.415	.45	4.65	.71	.249	.190	.152	.073	.019	.092
March	4.72	13.73	9.01	3.39	2.56	.305	.47	4.68	.70	.240	.187	.151	.086	.016	.084
April	4.54	13.69	9.15	3.43	2.66	.28	.44	4.70	.73	.243	.186	.155	.072	.019	.091
May	4.55	13.61	9.06	3.43	2.65	.37		4.76	.71	.252	.182	.159	.071	.025	.088

Table 3. The average composition of milk collected from June 1948 to May 1949 from various areas of Mississippi

Area	Butter fat pct.	Total solids pct.	Serum solids pct.	Total protein pct.	Casein pct.	Albumin pct.	Protein in albumin filtrate	Lactose pct.	Ash pct.	Phosphorus pct.	Calcium pct.	Potassium pct.	Sodium pct.	Magnesium pct.	Chloride pct.
Biloxi	4.53	13.52	8.99	3.49	2.68	.38	.45	4.71	.71	.245	.180	.153	.077	.025	.089
Hattiesburg	4.55	13.60	9.05	3.47	2.69	.33	.41	4.77	.705	.247	.179	.149	.073	.022	.086
Jackson	4.77	13.86	9.09	3.67	2.78	.40	.48	4.71	.72	.249	.181	.155	.075	.030	.090
Leland	5.32	14.95	9.63	3.69	2.79	.49	.43	4.85	.725	.255	.191	.138	.076	.024	.099
Olive Branch	4.45	13.11	8.66	3.42	2.62	.294	.392	4.56	.68	.232	.172	.143	.080	.023	.084
Starkville	4.81	13.76	8.95	3.56	2.74	.45	.35	4.63	.71	.239	.184	.146	.078	.024	.091
State College	4.60	13.85	9.25	3.72	2.77	.46	.49	4.74	.72	.241	.182	.150	.088	.027	.090
Tupelo	4.50	13.46	8.87	3.46	2.65	.35	.45	4.68	.68	.237	.178	.143	.066	.024	.090

are compared with other reports. This study shows that the month of May is the period when butterfat and total solids are low. For comparison, Jacobsen and Wallis (5) report August as the month during which the minimum values for these constituents were observed in South Dakota. Undoubtedly, the early growing season and the humidity factor in southern areas are largely responsible for this difference; as the summer season progresses accompanied by warm dry weather, the succulent pastures diminish favoring an increase in butterfat and total solids. It is also possible that the stage of lactation may be involved in the development of maximum and minimum constituent levels supplementing the seasonal influence as the case may be.

The butterfat and total solids trends did not show a seasonal duplication for spring 1948 and spring 1949. No information was available to explain these results except that the amount of rainfall during these two periods was quite different. During the spring season 1948 the rainfall was less than during the same period in 1949, and as a result of this, the pastures were showing a lack of moisture, while the same pastures during May 1949 were growing abundantly.

The butterfat and total solids values for each area studied generally followed the average trend as shown in tables 5 and 6.

The serum solids trend as shown in figure 2 and table 2 was lower during the summer than during the winter. Although the serum solids trend showed more irregularity than either the butterfat or total solids, it generally followed the latter. A low average of 8.60 percent serum solids appeared during March and a high of 9.34 percent was noted during September.

From the standpoint of minimum standards as established by law, the seasonal variations in milk become important especially during the months when these constituents are normally low. This study shows that the average low values for butterfat, total solids and serum solids are still above the minimum standards as established for the State of Mississippi. It further indicates that the total solids and serum solids come closer to the mini-

Table 4. Rainfall during January through June 1948 and 1949.

Year	January	February	March	April	May	June	July
1948	3.63	7.94	7.51	5.26	1.08	2.21	3.06
1949	13.85	5.84	5.84	3.96	6.17	4.96	3.68

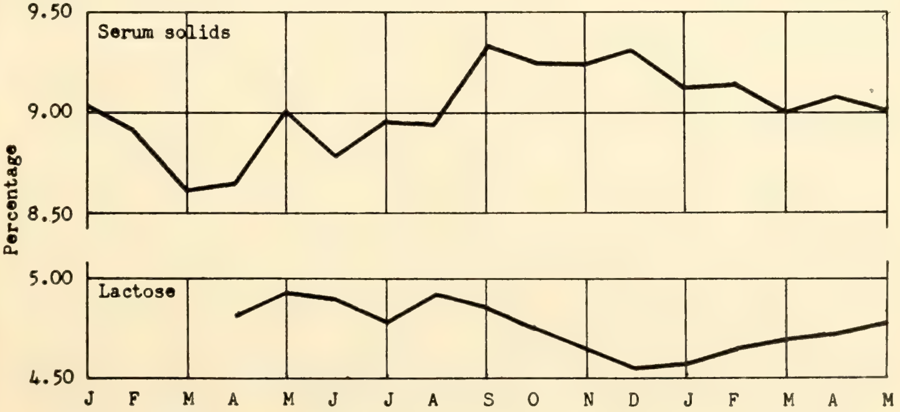

Figure 2. Seasonal trends of serum solids and lactose by months.

Table 5. Percent butterfat of different areas by calendar months.

Area	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May
Biloxi	5.2		4.35	4.55	4.8	4.0	4.2	4.5	4.9		5.1	4.7	4.8	4.3	4.5	4.45	4.4
Hattiesburg	5.2	4.35	4.3	4.3	4.3	4.4	4.5	4.5	4.7	4.7	5.1	4.0	4.75	4.4	4.8	4.2	4.6
Jackson	4.75	4.45	4.33	4.2	4.2	4.4	4.3	4.9	4.8	4.8	5.1	6.0	4.8	4.3	5.05	4.6	4.2
Leland	5.2		5.2	4.5	4.3	4.7		5.55	5.5	5.5	5.3	4.0	6.0	5.1	5.7	6.3	5.0
Olive Branch	4.8	4.5	4.2	4.15	3.8	4.0	4.3			5.1	5.3	4.1	4.7	4.55	4.0	4.0	
Starkville	4.7	4.6	4.0	4.1	4.2	4.4	4.5	4.7	4.85	5.5	5.5	5.4	5.2	4.8	4.5	4.0	4.4
State College	5.7	4.7	4.45	4.05	4.3	4.35	3.9	4.2	4.0	4.7	4.6	5.0	4.35	5.4	4.95	4.8	5.0
Tupelo	5.15	4.8	4.8	4.6	3.8		4.2	4.4	5.1	5.0	5.1	5.0	4.8	4.4	4.3	4.0	4.2

Table 6. Percent total solids in milk from different areas by calendar months.

Area	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May
Biloxi	13.30		12.73	13.00	13.05	12.71	12.78	13.20	14.34		14.40	13.60	13.73	13.14	13.45	13.37	13.31
Hattiesburg	14.90	13.57	13.45	12.76	13.26	12.57	13.19	13.05	13.91	14.30	14.35	13.95	13.72	13.40	13.86	13.10	13.70
Jackson	13.68	13.00	12.81	13.00	13.30	13.45	12.57	12.95	13.90	14.35	14.47	15.39	14.15	13.65	14.15	13.87	13.42
Leland	13.99		14.44	13.31	13.80	14.12		14.47	14.68	14.80	14.80	14.10	15.87	14.66	15.13	15.80	14.30
Olive Branch	14.17	13.08	12.36	12.35	12.95	12.62	12.26			14.04	14.22	12.92	13.15	13.36	12.60	12.85	
Starkville	13.87	13.15	12.41	13.14	13.10	12.95	12.73	13.50	14.13	14.65	14.80	14.45	14.27	13.75	13.41	13.07	13.40
State College	14.94	15.03	14.04	12.88	13.30	12.98	13.03	13.15	13.85	13.80	14.00	14.45	13.75	14.89	14.10	14.20	14.05
Tupelo	14.00	12.75	12.19	12.98	12.15		12.57	12.75	14.30	14.12	14.29	13.84	13.69	13.26	13.16	13.05	13.10

Table 7. Percent total protein in milk from various areas by calendar months.

Area	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May
Biloxi	3.47		3.56	3.57	3.50	3.35	3.44	3.49	3.89		3.70	3.45	3.46	3.55	3.34	3.43	3.36
Hattiesburg	3.60	3.42	3.42	3.41	3.58	3.24	3.27	3.43	3.71	3.78	3.72	3.69	3.50	3.33	3.38	3.29	3.42
Jackson	3.42	3.18	3.57	3.56	3.56	3.59	3.40	3.52	3.80	3.90	3.90	3.90	3.70	3.85	3.55	3.48	3.48
Leland	3.65		3.85	3.54	3.75	3.76	3.43	3.61	3.63	3.58	3.75	3.72	4.20	3.80	3.72	3.55	3.60
Olive Branch	3.65	3.11	2.96	3.17	3.29	3.19	3.30	3.48	3.68	3.88	3.65	3.60	3.20	3.30	3.05	3.35	
Starkville	3.68	3.16	3.21	3.25	3.52	3.27	3.38	3.47	3.60	3.82	3.83	3.80	3.80	3.55	3.38	3.36	3.37
State College	3.80	3.92	3.64	3.82	3.63	3.75	3.63	3.64	3.75	3.83	3.98	3.83	3.79	3.71	3.64	3.68	3,45
Tupelo	3.58	3.25	2.77	3.45	3.44		3.14	3.28	3.80	3.82	3.83	3.60	3.50	3.35	3.11	3.34	3.33

mum standards than the fat content. This means that the normally secreted milk which may not meet the minimum standards would likely be low in either total solids or serum solids rather than in butterfat.

The protein content of the milk studied also varied seasonally. Data shown in figure 3 and table 2 indicated that the total protein was low during the spring season and high during the fall and early winter season, which was similar to the butterfat, total solids and serum solids trends. The maximum average was noted during November at 3.83 percent and the minimum was observed during February at 3.34 percent. Although the plotted curves showed some irregularities, the total protein gradually decreased from November through March remaining at a low level from March through July, and then steadily increased from July to November. This same seasonal pattern in protein levels was found for the milk analyzed from each area, as shown in table 7.

Casein, which represents almost four-fifths of the milk protein, followed and appeared largely responsible for the overall fluctuation in the total protein content. The results as plotted in figure 3 and expressed in table 2 showed that the highest average for casein appeared during November at 2.89 percent while the

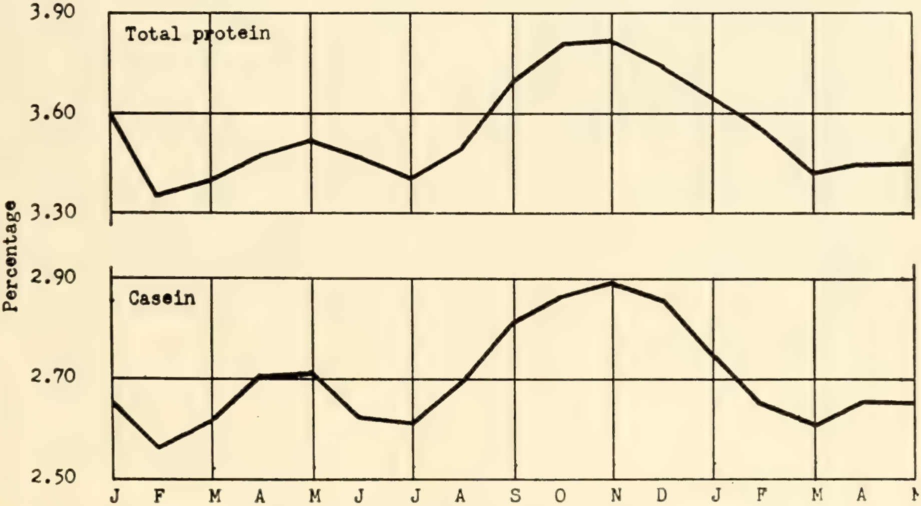

Figure 3. Seasonal trends of total protein and casein by months.

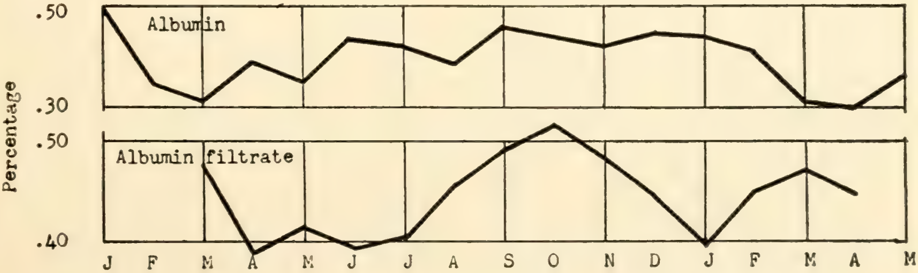

Figure 4. Seasonal trends of albumin and protein in albumin filtrate by months.

Table 8. Percent casein in milk from various areas by calendar months.

Area	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May
Biloxi	2.14		2.80	2.81	2.74	2.60	2.73	2.60	2.89		2.97	2.60	2.66	2.55	2.58	2.75	2.65
Hattiesburg	2.66	2.56	2.69	2.72	2.82	2.59	2.59	2.70	2.90	2.84	2.80	2.77	2.81	2.50	2.65	2.53	2.70
Jackson	2.65	2.64	2.62	2.76	2.76	2.61	2.60	2.83	2.88	2.86	2.88	2.90	2.71	2.99	2.70	2.78	2.61
Leland	2.85		3.08	2.84	2.89	2.93	2.63	2.83	2.65	2.52	2.76	2.79	3.10	2.91	2.81	2.79	2.80
Olive Branch	2.65	2.48	2.26	2.62	2.49	2.49	2.50	2.26	2.77	3.09	2.91	2.72	2.59	2.49	2.40	2.60	
Starkville	2.78	2.61	2.45	2.49	2.79	2.54	2.72	2.73	2.79	2.95	2.85	2.86	2.85	2.67	2.53	2.78	2.55
State College	2.85	3.02	2.80	2.89	2.77	2.68	2.73	2.70	2.87	2.81	3.00	2.98	2.77	2.71	2.70	2.78	2.60
Tupelo	2.69	2.01	2.11	2.69	2.70		2.39	2.45	2.80	2.99	3.00	2.79	2.66	2.53	2.35	2.59	2.65

Table 9. Percent albumin in milk from various areas by calendar months.

Area	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.
Biloxi	.325		.305	.35	.40	.38	.41	.36	.42		.30	.45	.38	.35	.38	.33
Hattiesburg	.30	.285	.35	.37	.34	.42	.33	.36	.38	.42	.47	.34	.33	.30	.26	.15
Jackson	.29	.25	.31	.44	.35	.37	.45	.33	.41	.44	.40	.65	.39	.33	.32	.35
Leland	.38		.39	.42	.25	.46	.54	.51	.74	.42	.52	.53	.75	.44	.33	.25
Olive Branch	.86	.26	.275	.37	.40	.39	.29			.33	.45	.42	.30	.28	.21	.27
Starkville	.80	.42	.315	.46	.35	.60	.52	.40	.40	.41	.50	.45	.65	.50	.26	.32
State College	.63	.37	.37	.335	.39	.47	.45	.45	.52	.32	.47	.43	.55	.72	.45	.31
Tupelo	.44	.55	.20	.30	.34		.39	.37	.37	.44	.37	.41	.28	.40	.23	.25

Table 10. Percent ash in milk from various areas by calendar months.

Area	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May
Biloxi	.715		.75	.70	.725	.75	.695	.75	.71		.71	.715	.70	.71	.70	.76	.71
Hattiesburg	.75	.73	.77	.705	.705	.69	.705	.72	.705	.71	.69	.715	.675	.705	.71	.76	.71
Jackson	.79	.685	.765	.68	.73	.74	.67	.735	.74	.66	.73	.73	.75	.74	.74	.78	.71
Leland	.86		.77	.755	.78	.755	.705	.71	.74	.71	.72	.74	.76	.67	.72	.75	.73
Olive Branch	.715	.68	.67	.655	.655	.67	.70	.60	.69	.70	.73	.705	.67	.69	.66	.71	
Starkville	.755	.67	.66	.72	.68	.70	.695	.68	.77	.72	.70	.70	.72	.73	.725	.70	.72
State College	.705	.76	.71	.72	.74	.705	.655	.68	.72	.75.	75	.73	.79	.77	.74	.72	.705
Tupelo	.695	.69	.665	.69	.695		.65	.685	.71	.705	.67	.72	.70	.68	.64	.70	.69

lowest percent was observed during February at 2.55. Declining gradually from November through March, the average casein trend remained low from March through July and then steadily increased from July to November. Both the protein and casein percentages showed about the same trend for the spring of 1948 and 1949. The data in table 8 compare the casein content in the milk analyzed from eight areas for each calendar month. Generally, each area followed the average of all areas.

The albumin portion of milk protein of the samples analyzed did not follow the casein trend; however, it did show a seasonal variation. The plotted values in figure 4 based on the results in table 2 indicate that a decline in the albumin content developed from January through March. The albumin content increased during May through July and remained high through the summer and fall until January. The highest point attained for albumin was .50 percent during January and the lowest average appeared during February and March at .28 percent. Generally, the albumin trend for each area was not as consistent with the average of all areas as was true for the casein trend.

The remaining protein not coagulated by heat in the albumin determination was designated as the protein in the albumin filtrate. This portion undoubtedly contained globulin, lesser proteins and other nitrogen bearing compounds. Although the amount of analyzed protein in this filtrate varied more than the albumin portion, the quantity of protein in this fraction averaged the same as the albumin content. The trend as shown in figure 4 and table 2 indicated a possible high level during the late summer and fall followed by a low content from April through July. The maximum portion of protein in the albumin filtrate was observed in October at .52 percent, while a low of .38 to .39 percent was noted during January, April and July.

Considering the protein trend and its relationship with other milk constituents, a close similarity is indicated between the total protein and the butterfat content. As the butterfat content increased, a similar increase in total protein was evident. Furthermore, the variations in milk protein largely determine the fluctuations in serum solids. This was observed from the

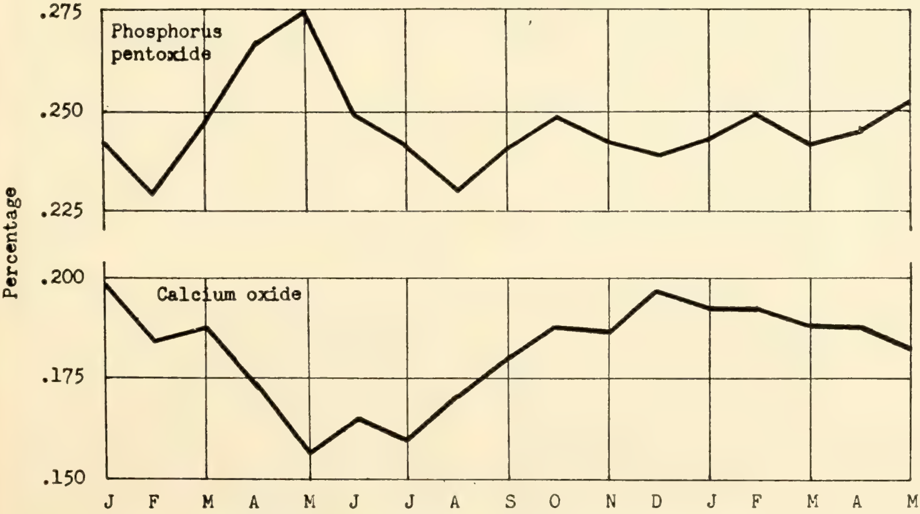

Figure 5. Sasonal trends in calcium oxide and phosphorus pentoxide by months.

fact that the month during which the maximum values in serum solids was noted coincided with the same criteria for total protein. These data are in agreement with the findings as reported by Davis and co-workers (2) at the Arizona Experiment Station and with the report of Overman (6) at the Illinois Experiment Station.

Another variable milk constituent was lactose, more commonly referred to as milk sugar. Although this constituent is one of the larger components of milk, it varied less from season to season than many of the other constituents. Generally. the lactose percentage was slightly higher during the spring and summer than it was during the winter. The highest average lactose content was observed during May and August at 4.88 percent, and the lowest amount was noted during December at 4.56 percent, as shown in figure 2 and table 2. Declining gradually from August through December, the lactose content tended to increase during the spring and summer season. This trend was directly opposite the trends established by butterfat, total solids, serum solids. and total protein. These observations are in agreement with Davis (2) et al and Overman et al (6), in which both workers concluded that an inverse relationship exists between the lactose content and the butterfat, total solids, serum solids, and total protein content.

The ash content, which includes a mixture of all milk minerals, also showed a seasonal fluctuation. Although the results secured show only slight variations, the ash content was higher during the winter season than it was during July and August, as is shown in figure 6 and table 2. The maximum ash content appeared in January at .74 percent, and the minimum value was secured during July at .68 percent. This trend varied inversely with the lactose values and followed the butterfat, total solids, total protein, and serum solids variations.

The results in table 10 show the ash content for each area by calendar month.

Although the total mineral content varied somewhat, the individual constituents making up the ash followed a more definite seasonal pattern. This was especially true for phosphorus which tended to be high during the early spring and low during the summer and early fall and then increased somewhat during the early winter season. The results as shown in figure 5 and table 2 showed a maximum of .277 percent for phosphorus pentoxide during May and a low of .228 percent during February. An increasing trend was noted from February through May, followed by a decline to a near low during August. From July through October, it increased again and then remained fairly uniform until spring. The sharp seasonal increase observed from March through May during 1948 did not repeat during the same months of 1949; however, the analysis for May 1949 showed an increase in the phosphorus trend, indicating that a delayed seasonal influence in this constituent was involved. This same lack of seasonal duplication was observed with the butterfat which was discussed previously.

While the phosphorus tended to increase with the spring season, calcium showed a somewhat inverse trend as shown in figure 5 and table 2. Generally, the calcium averaged low during the spring and summer and high during the winter season. The trend decreased from March through July, and gradually increased to a high point during December. The maximum calcium oxide percentage of .201 percent was noted during January while the minimum of .157 percent was observed during May. The lack of seasonal repetition that was noted with phosphorus also appeared with the calcium content. Data in figure 5 showed a slower decline in spring 1949 than was observed for the same period 1948. It was significant, however, that a decline was

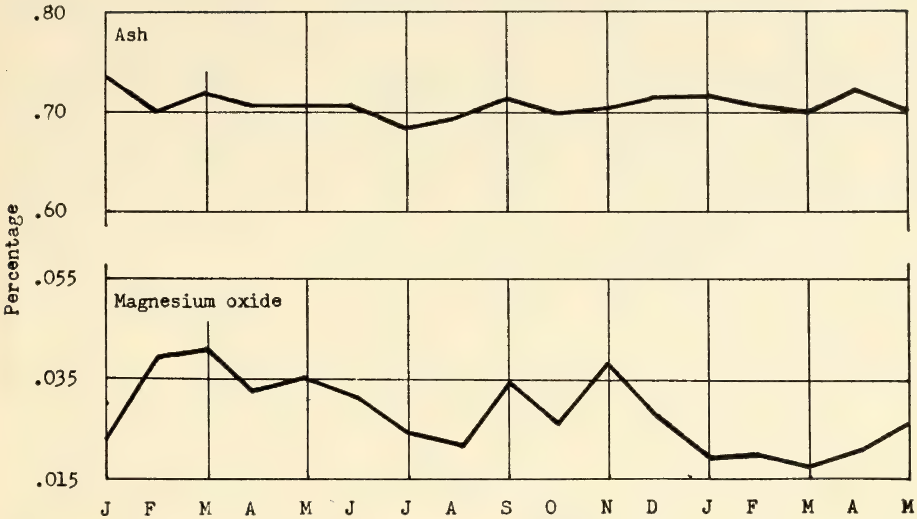

Figure 6. Seasonal trends of ash and magnesium oxide by months.

indicated in the last two months' analyses for 1949.

The results secured in the phosphorus and calcium determinations are in general agreement with the findings of Jacobsen and Wallis (5) who report that the mineral percentage was lower during the summer than during the winter; their results, however, did not show the early spring increase in phosphorus that was observed with Mississippi-produced milk.

The ratio of calcium to phosphorus also varied from season to season. A calcium-phosphorus ratio of 0.94 to 1.00 was noted during May while a ratio of 1.40 to 1.00 was found for December. A gradually increasing ratio was observed from August through December, while from January through May the ratio decreased slightly.

The calcium content varied almost directly with the total solids content, while the prosphorus levels showed some correlation with total solids except for the early spring upward trend that developed. Since the stability of milk proteins is partially dependent upon the balance between calcium and phosphorus, it is evident that milk characteristics involving protein stability would vary from season to season. When the calcium to phosphorus ratio is high the milk would react differently in processing than when the ratio is low. Accordingly, this study shows that more problems involving feathering in coffee cream and coagulation during cooking with Mississippi milk should be experienced during the winter season. Furthermore, winter milk will have a faster rate of rennet action and will favor a lower moisture cheese than spring milk. The technician in the evaporated milk plant must also take this varying ratio into consideration in adjusting his hot well and sterilizing temperature to secure a uniform product throughout the year.

Data shown in tables 11 and 12 are the calcium and phosphorus determinations for each month from milk produced in the different areas. Generally, each area followed the average seasonal trend.

The magnesium trend shown in figure 6 fails to follow any seasonal pattern. A lack of seasonal duplication was noticed especially when January through May of 1948 is compared with the same

Table 11. Percent phosphorus (P_2O_5) in milk from various areas by calendar months.

Area	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May
Biloxi	.240		.220	.270	.273	.252	.240	.239	.254		.249	.239	.237	.253	.244	.243	.251
Hattiesburg	.274	.245	.264	.262	.265	.234	.237	.231	.248	.254	.250	.251	.245	.260	.244	.251	.255
Jackson	.213	.243	.266	.249	.274	.260	.247	.244	.254	.255	.255	.240	.248	.245	.243	.252	.249
Leland	.243		.270	.280	.288	.278	.245	.237	.247	.261	.253	.244	.264	.255	.260	.258	.261
Olive Branch	.232	.204	.216	.233	.250	.257	.238	.225	.234	.237	.223	.220	.222	.240	.229	.237	
Starkville	.265	.218	.255	.255	.275	.244	.240	.239	.238	.245	.241	.235	.238	.244	.233	.232	.250
State College	.235	.242	.266	.275	.291	.240	.220	.233	.242	.255	.244	.235	.245	.250	.237	.233	.248
Tupelo	.247	.220	.204	.263	.284		.240	.218	.239	.241	.235	.230	.233	.248	.235	.245	.249

Table 12. Percent calcium (CaO) in milk from various areas by calendar months.

Area	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May
Biloxi	.211		.170	.195	.160	.179	.165	.177	.188		.180	.188	.193	.182	.185	.176	.177
Hattiesburg	.210	.185	.199	.182	.160	.159	.154	.167	.181	.186	.180	.189	.191	.187	.187	.186	.184
Jackson	.223	.190	.184	.156	.174	.165	.153	.172	.180	.191	.190	.190	.188	.195	.190	.186	.180
Leland	.251		.209	.196	.185	.173	.167	.181	.183	.194	.205	.200	.202	.194	.203	.210	.187
Olive Branch	.174	.170	.175	.160	.157	.156	.157	.165	.167	.183	.174	.187	.180	.181	.180	.170	
Starkville	.205	.195	.208	.176	.156	.166	.163	.175	.181	.198	.200	.196	.188	.191	.183	.184	.184
State College	.198	.180	.187	.155	.147	.170	.159	.169	.174	.180	.184	.195	.190	.200	.184	.195	.189
Tupelo	.210	.190	.167	.150	.138		.161	.166	.186	.176	.170	.188	.186	.185	.186	.185	.178

Table 13. Percent magnesium (MgO) in milk from various areas by calendar months.

Area	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May
Biloxi	.010		.050	.048	.024	.035	.018	.024	.038		.037	.023	.025	.019	.011	.015	.031
Hattiesburg	.031	.037	.04	.023	.045	.017	.015	.009	.031	.020	.044	.013	.028	.021	.022	.017	.025
Jackson	.020	.042	.042	.044	.051	.039	.027	.029	.027	.037	.047	.040	.019	.022	.025	.023	.029
Leland	.045		.06	.013	.05	.030	.013	.013	.045	.019	.030	.036	.012	.020	.011	.020	.025
Olive Branch	.014	.050	.045	.027	.045	.035	.018	.028	.036	.024	.037	.016	.022	.020	.009	.015	
Starkville	.033	.045	.035	.027	.030	.031	.027	.024	.031	.020	.040	.044	.017	.013	.020	.018	.019
State College	.027	.050	.036	.035	.025	.031	.023	.020	.045	.023	.034	.043	.012	.016	.024	.020	.029
Tupelo	.023	.058	.038	.050	.033		.019	.023	.027	.023	.047	.024	.023	.023	.009	.021	.019

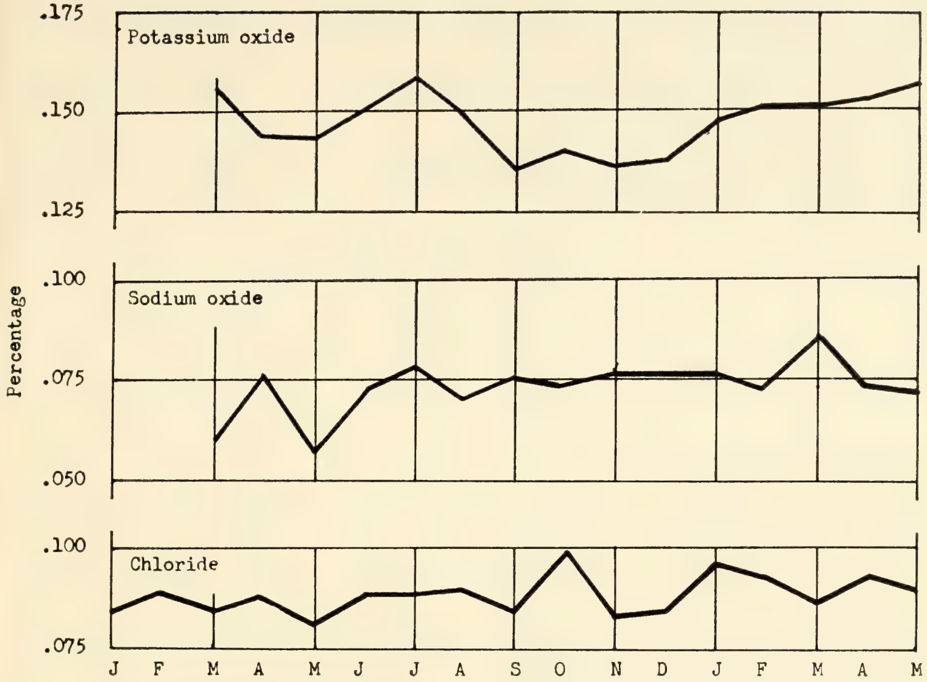

Figure 7. Seasonal trends in potassium oxide, sodium oxide and chloride by months.

months for 1949. The maximum value for magnesium of .043 percent was noted during March 1948 while the lowest point of 0.19 percent was noted during March 1949. Since the quantity of magnesium present in milk is relatively small, it would appear that some experimental error may be involved in this determination. This fact might account for the lack of seasonal duplication.

Further data on the magnesium content are found in table 13 in which the monthly percentages for each area are tabulated.

Potassium in milk was shown to vary somewhat with the season. Generally, the potassium content was lower during the early fall than it was during early spring. The lowest point noted for potassium appeared during September and November at .135 percent potassium oxide while the highest level was observed during July at .164 percent potassium oxide. The plotted values for potassium which are shown in figure 7 appeared to be somewhat inversely related to the butterfat, protein and calcium trends; however, a tendency for a direct relationship between lactose and potassium was noted. Further data on the potassium trends for each area studied are given in table 15.

The sodium content was fairly uniform, showing very little seasonal variation. The plotted trend as represented in figure 7 and table 2 showed a maximum average of .086 percent sodium oxide during March and a minimum of .054 percent sodium oxide for May. The sodium trend indicated little, if any, relationship to other milk constituents.

The chloride percentage remained fairly uniform throughout the study with no definite seasonal trend nor excessive fluctuation apparent. The plotted monthly values which are shown in figure 7 varied between .098 percent chloride in October

Table 14. Percent lactose in milk from various areas by calendar months.

Area	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May
Biloxi	5.03	5.00	4.80	4.81	4.90	4.85	4.75		4.60	4.62	4.60	4.61	4.60	4.70
Hattiesburg	4.65	4.83	4.81	4.92	4.83	4.86	5.00	4.70	4.53	4.62	4.78	4.76	4.72	4.80
Jackson	4.87	4.96	4.91	4.63	4.86	4.71	4.96	4.60	4.60	4.56	4.56	4.58	4.70	4.83
Leland	5.10	4.86	5.12	4.65	5.02	4.90	5.00	4.75	4.72	4.80	4.75	4.80	4.86	4.83
Olive Branch	4.60	4.70	4.76	4.45			4.47	4.55	4.44	4.48	4.62	4.75	4.60	
Starkville	4.83	4.90	4.80	4.63	4.73	4.70	4.71	4.64	4.50	4.41	4.53	4.55	4.67	4.72
State College	4.84	4.90	4.86	4.90	4.92	4.81	4.60	4.53	4.66	4.63	4.83	4.64	4.79	4.75
Tupelo	5.03	4.98		4.89	4.94	4.76	4.66	4.59	4.48	4.50	4.57	4.68	4.70	4.71

Table 15. Percent potassium (K_2O) in milk from various areas by calendar months.

Area	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May
Biloxi		.180	.166	.156	.157	.171	.150	.156		.142	.148	.146	.155	.155	.146	.166
Hattiesburg	.150	.156	.142	.136	.151	.157	.140	.133	.156	.136	.141	.150	.141	.160	.164	.161
Jackson		.183	.168	.168	.170	.176	.142	.137	.159	.137	.140	.167	.167	.167	.153	.165
Leland		.141	.151	.125	.122	.132	.142	.134	.142	.125	.134	.155	.148	.140	.143	.139
Olive Branch	.168	.175	.155	.146	.155	.175	.142	.116	.130	.125	.125	.139	.143	.150	.172	
Starkville	.155	.180	.101	.137	.160	.166	.148	.140	.130	.134	.125	.123	.161	.156	.159	.162
State College	.155	.162	.135	.150	.148	.169	.160	.140	.139	.141	.144	.155	.160	.140	.150	.155
Tupelo	.151	.134	.168	.152		.166	.136	.124	.142	.136	.139	.141	.140	.139	.152	.159

Table 16. Percent sodium (Na_2O) in milk from various areas by calendar months.

Area	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May
Biloxi	.060	.065	.057	.100	.098	.051	.062		.086	.081	.066	.077	.080	.076	.070
Hattiesburg	.061	.105	.064	.053	.065	.071	.070	.077	.073	.080	.083	.045	.080	.093	.087
Jackson	.060	.089	.040	.056	.064	.070	.092	.085	.085	.074	.073	.094	.080	.077	.072
Leland	.051	.090	.070	.101	.101	.102	.087	.061	.074	.075	.057	.080	.086	.043	.069
Olive Branch	.041	.092	.060	.103	.097	.056	.065	.079	.068	.075	.085	.071	.094	.088	
Starkville	.045	.077	.045	.078	.095	.068	.084	.099	.076	.067	.064	.083	.101	.056	.060
State College	.087	.023	.068	.095	.102	.067	.096	.100	.085	.095	.095	.076	.090	.090	.071
Tupelo	.064	.087	.034		.044	.069	.048	.071	.072	.070	.085	.061	.075	.059	.071

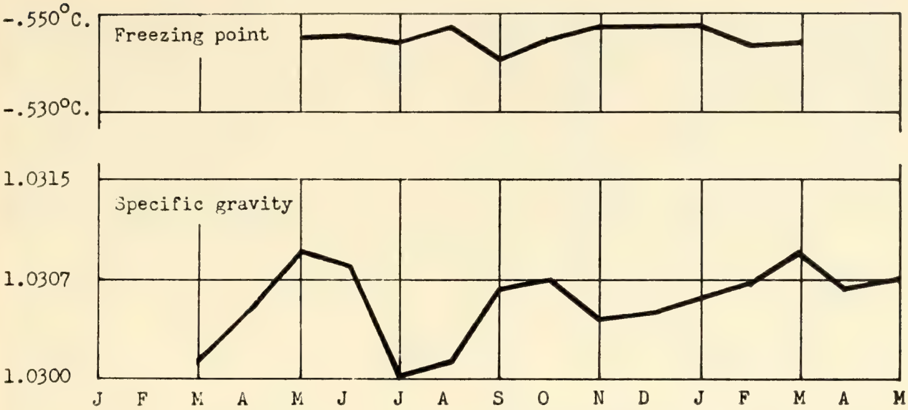

Figure 8. Seasonal trends in freezing point and specific gravity by months.

to a low of .081 percent chloride during May. There was no relationship between the chloride content and the other constituents.

The results of the freezing point determinations and the lactometer readings are shown in figure 8. No correlation exists between the two plotted results. The freezing point values were more uniform than the lactometer readings, and the lowest freezing point was noted during September at -.541° C. while the highest value was observed during December and January at -.547° C. The lactometer reading followed a greater seasonal variation than the freezing point determinations. The lactometer readings were lower during July and August than they were for the remaining months. The highest lactometer readings 1.0314 was observed in March and May and the lowest reading of 1.0299 occurred in July.

The titratable acidity did not vary directly with the pH values. Very little seasonal difference in either of these determinations was noticeable; however, the pH tended to be slightly higher during December to February than during the remaining periods. The titratable acidity was low for July and February and otherwise tended to vary irregularly. The seasonal trends for pH and titratable acidity are shown in figure 9.

A general view of seasonal trends in the composition of milk produced in Mississippi will show some influence which is related to the climatic conditions of this region. The early seasonal decline in butterfat, total solids and protein coincides very closely with the early growing season. As this growing season extends into July which is frequently accompanied by hot, dry weather, a sharp increase in these constituents develops which continues upward until November. Undoubtedly, the decline in succulent grass pastures is partially responsible for this upward trend during the late summer, but it may be further implemented by the fact that many animals approach the later stages of lactation with the early fall season, and continue into winter with little or no milk production in preparation for calving during early spring. Thus, the combined influence of lactation and season might be responsible for the maximum variations secured in the milk constituents from season to season.

Higher yields in cheese manufacture and evaporated milk processing are possible during the winter months than during the summer. However, a greater degree of butterfat standardization may be practiced during the winter because of the higher fat content. Problems involving milk stability will occur more fre-

Table 17. Percent chloride (Cl) in milk from various areas by calendar months.

Area	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May
Biloxi	.090		.099	.089	.088	.088	.086	.086	.095		.089	.089	.098		.080	.095	.083
Hattiesburg	.090	.092	.081	.079	.082	.085	.084	.084	.094	.083	.082	.088		.087		.092	.088
Jackson	.081	.087	.086	.082	.076	.084	.089	.089	.097	.091	.081	.100	.098	.099	.082	.089	.083
Leland	.076		.070	.092	.089	.087	.087	.088	.097	.085	.078	.084	.110	.096		.087	.091
Olive Branch	.085	.091	.082	.082	.069	.078	.079			.084	.084	.088	.087	.086		.090	
Starkville	.086	.086	.091	.084	.077	.094	.091	.088	.094	.089	.090	.094	.097	.089	.085	.092	.091
State College	.084	.091	.090	.092	.085	.095	.086	.093	.090	.088	.082	.092	.090	.093	.090	.090	.093
Tupelo	.078	.083	.067	.089	.086		.088	.088		.093	.089	.094	.088	.095		.090	.087

Table 18. A twelve-month average of some constituents calculated on basis of total solids of milk collected from various soil areas.

Soil classifications as to mineral content	Total solids pct.	Total protein pct.	Lactose pct.	Calcium (CaO) pct.	Phosphorus (P_2O_5) pct.	Potassium (K_2O) pct.	Total protein in total solid pct.	Lactose in total solids pct.	Calcium (CaO) in total solids pct.	Phosphorus (P_2O_5) in total solids pct.	Potassium (K_2O) in total solids pct.
Very high in Ca, P & K	14.95	3.69	4.85	.191	.255	.138	24.68	32.44	1.27	1.70	.922
High in Ca, medium in P&K	13.69	3.56	4.66	.181	.239	.146	26.00	34.03	1.32	1.74	1.06
Medium in Ca, P & K	13.86	3.67	4.71	.181	.249	.155	26.47	33.98	1.30	1.79	1.11
Low in Ca, P & K	13.36	3.45	4.66	.176	.239	.146	25.82	34.88	1.31	1.78	1.09
Very low in Ca, P & K	13.52	3.49	4.71	.180	.245	.153	25.81	34.83	1.33	1.81	1.13

Table 19. Average composition of milk collected from June 1948 to May 1949 from various soil conditions.

Soil classifications as to mineral content	Butter fat pct.	Total solids pct.	Serum solids pct.	Total protein pct.	Casein pct.	Albumin pct.	Protein in albumin pct.	Lactose pct.	Ash pct.	P_2O_5 pct.	CaO pct.	K_2O pct.	Na_2O pct.	MgO pct.	Cl pct.
Very high in Ca, P & K	5.32	14.95	.9.63	3.69	2.79	.49	.43	4.85	.725	.255	.191	.138	.078	.024	.099
High Ca, medium in P & K	4.66	13.69	9.03	3.56	2.72	.42	.43	4.66	.70	.239	.181	.146	.077	.025	.090
Medium in Ca, P & K	4.77	13.86	9.09	3.67	2.78	.40	.48	4.71	.72	.249	.181	.155	.075	.030	.090
Low in Ca, P & K	4.50	13.36	8.86	3.45	2.65	.31	.40	4.66	.69	.239	.176	.146	.077	.022	.085
Very low in Ca, P & K	4.53	13.52	8.99	3.49	2.68	.38	.45	4.71	.71	.245	.180	.153	.077	.025	.089

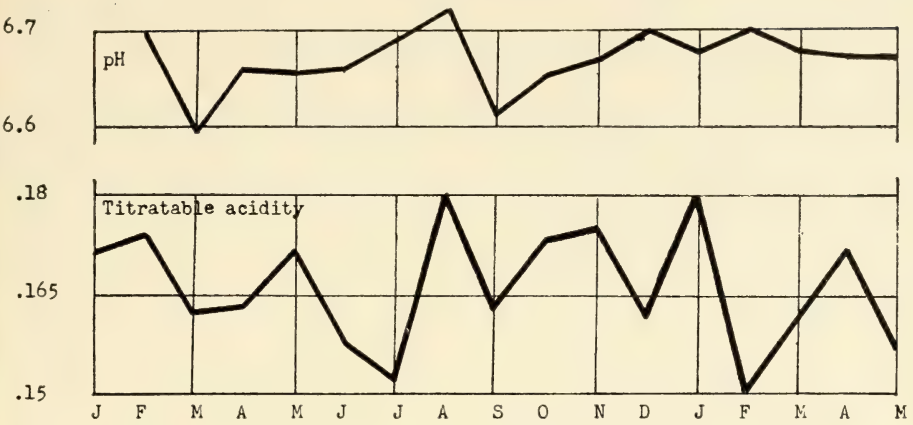

Figure 9. Seasonal trends of pH and titratable acidity by months.

quently during the winter season than during the summer.

The seasonal trends in milk constituents observed for Mississippi milk generally follow that of other regions. Some difference in maximum variation and the months of minimum and maximum values are shown.

Composition From Various Soil Areas

The composition of the soil is known to influence the rate and amount of herbage growth as well as the composition of the herbage. However, less is known regarding the effect of soil composition on the constituents of milk produced by cows grazing on this soil area. In order to determine the relationship, if any, between the actual soil fertility and the composition of milk produced, it would be necesary to know the complete analysis and quantities of feeds consumed by cows. This study was not planned for such a comprehensive undertaking but was set-up to determine the composition of milk delivered by the average patron under average farm conditions. The results of this study, therefore, would not scientifically correlate the soil fertility with milk composition under average farm conditions.

In this study it so happened that the area having a soil rated very high in calcium, phosphorus and potassium supplied milk from a breed which normally produces milk having a high butterfat and total solids content and a herd kept in good physical condition. The milk from this area had the highest butterfat, total solids, serum solids, total protein, lactose, ash, calcium and phosphorus content and averaged the lowest potassium content. Since the breed is less of a factor in the other four soil type areas ranging from high in calcium and medium in phosphorus and potassium to a soil rated very low in these minerals, a direct comparison between the milk produced by cows grazing on these four soil types would be more significant.

The butterfat, total solids and serum solids in the milk samples studied showed no relationship to the mineral content of the soil area in which the milk was produced. The same result was observed with respect to the protein in the milk. Milk produced in a soil area rated very low in calcium, phosphorus and potassium averaged .07 percent less butterfat and protein than milk produced in a soil area rated high in these elements.

The lactose content was noticeably uniform in the samples secured from the different soil areas. One exception noted was that a slightly higher amount of lactose was found in the milk produced in a soil area rated very low in calcium, phosphorus and potassium.

All samples showed a lack of correlation between the ash, calcium, phosphorus, potassium, sodium, magnesium and chloride content in the milk and the mineral richness of the soil in the area of production. In fact, the phosphorus and potassium content in the milk samples were slightly higher in the milk secured from soil areas rated low in calcium, phosphorus and potassium. Except for a lack of information of the amount of supplemental feeding the results suggest that the mineral content of the soil had little influence on milk composition.

Further indication that the minerals in the milk were not significantly different was noted in the freezing point and lactometer values. The freezing point values and lactometer readings were very uniform in the milk from various soil areas. The only exception that developed was noticed in the milk samples secured from a soil area rated very high in calcium, phosphorus and potassium. In this instance, the milk tended to have a higher freezing point and a higher lactometer reading. Again, the breed predominance in this area must be taken into consideration.

Rusoff and Seath (7) report that supplementing a mineral deficient ration with more calcium and phosphorus did not increase or alter the calcium and phosphorus levels in the blood plasma. They further add that no significant increase in milk production resulted by adding these minerals to the ration. While this does not imply that the calcium and phosphorus levels in milk would necessarily be affected, it does seem logical that the milk minerals would also show little correlation to the amount of these constituents in a ration. Furthermore, it is generally agreed by nutritionists and herdsmen that a ration deficient in calcium and phosphorus will cause the cow to draw upon the calcium supply in her bones and teeth in order to maintain a milk supply of normal composition. However, as Becker and others(1) point out, such practice will ultimately result in excessive bone fractures and low milk production. So it seems that the dairy cow will produce milk of a reasonable normal composition as long as the ration is adequate or the reserved constituents in her body are available; when both of these are exhausted, the milk production will decline rather than continue high with an abnormal composition.

While no correlation existed between the milk constituents and the calcium, phosphorus and potassium in the soil, a very definite relationship existed between the total solids content and the other milk ingredients. Considering all milk samples, the milk containing the highest percent of total solids also contained the highest percent of butterfat, serum solids, total protein, casein, ash, phosphorus and calcium. Similarly, the milk having the least total solids was low in the other constituents. Thus a direct relationship was observed between the total solids and the butterfat, serum solids, total protein, casein, phosphorus, calcium and ash. However, the lactose and potassium varied inversely with the total solids content. These findings are in general agreement with the conclusions of Overman (6).

Table 19 further compares some of the milk constituents on the basis of soil richness, and these data indicate the lack of influence of soil richness on the constituents studied in the milk samples.

Summary and Conclusion

Representative milk samples from Biloxi, Hattiesburg, Jackson, Leland, Olive Branch, Tupelo, Starkville and State College, Mississippi, were selected and analyzed each month through 17 calendar months.

The milk samples were analyzed for butterfat, total solids, total protein, casein, albumin, protein in albumin filtrate, lactose, ash, calcium, magnesium, phosphorus, sodium, potassium, chloride, specific gravity, pH, freezing point and titratable acidity.

Higher levels of butterfat, total solids, total protein, casein, ash, calcium and phosphorus were found in the Mississippi milk than were reported for northern analyses. Less lactose, potassium and chloride, however, were found in the milk analyzed than were reported for other areas. The results further indicated a higher ratio of butterfat to total solids, a higher ratio of total protein and casein to serum solids, and a lower ratio of lactose to serum solids than was reported for northern analyses.

The composition of the milk varied from season to season. Generally, the butterfat, total solids, serum solids, total protein, casein, ash and calcium were higher during the winter than during the summer. Phosphorus, except for an early spring increase, varied with the calcium trend. The percent lactose and potassium appeared to be high during the summer and low during the winter. Sodium, chloride and magnesium did not show a seasonal variation. The freezing point varied slightly from winter to summer and the lactometer also showed some variation; no definite seasonal trend was observed in either pH or titratable acidity.

A direct relationship between the butterfat, total solids, serum solids, total protein, casein and calcium was observed. An inverse relationship between these constituents and lactose and potassium was noted. The phosphorus tended to vary with the calcium except for an early seasonal increase in spring followed by a low in August. Ash tended to vary inversely with the lactose content.

The composition of milk produced within the state was quite uniform. Milk samples were selected from areas having a soil rated as very high in calcium, phosphorus and potassium to a soil rated very low in these elements. A slight difference in the butterfat, total solids and protein content was noticed but these variations were not definitely related to the soil condition.

The calcium and phosphorus content of milk from various areas of Mississippi did not vary with the mineral content of soil in the area. A region classed as low in soil minerals supplied milk equal in calcium and phosphorus to a milk produced on a soil area rated high in these constituents. Potassium levels also failed to show any correlation with the quantity of this element in the soil. In fact, the soil area rated the highest in potassium supplied a milk averaging the lowest amount of potassium.

While a direct relationship between the soil mineral levels and the percent of these same elements in milk was not evident, a definite relationship was observed between the calcium and phosphorus content and the total solids content. Furthermore, there was evidence that the lactose content tended to increase as the total solids content decreased.

This study shows that milk produced in Mississippi has a composition within range of other reported composition studies. It indicates that many of the constituents are variable from season to season. It establishes the uniformity of composition in the different regions of the State.

The results of this study suggest that the cheese manufacturer will experience a faster rennet action and a dryer curd formation during the fall and winter. The manufacturer of evaporated milk will likely experience more problems involving milk stability during the fall and winter. It generally shows that if problems in coffee cream feathering, in coagulation of milk during home cooking, and inability to withstand heat treaments are to occur, these will likely appear during the fall and winter.

Higher yields in evaporated milk processing and in cheese manufacture are secured in the winter season than during the summer.

The normal low levels of fat, total solids and solids-not-fat that develop in spring and summer are well within the standards as established by law in Mississippi.

The differences in the results of this study from other milk analyses appear to be largely due to breed rather than any other single factor. However, the climatic conditions and possibly the practice of having cows freshen in the early spring favor an earlier decline in some constituents than is reported in northern areas.

The high maximum variation in butterfat and total solids from winter to summer suggest that better feeding programs can be followed especially in the winter season.

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Coahoma County Soils

BULLETIN 475 JULY 1950

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
FRANK J. WELCH, Director
STATE COLLEGE MISSISSIPPI

SOIL SURVEY PARTY FOR COAHOMA COUNTY

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The above surveyors participated in the mapping of Coahoma County.

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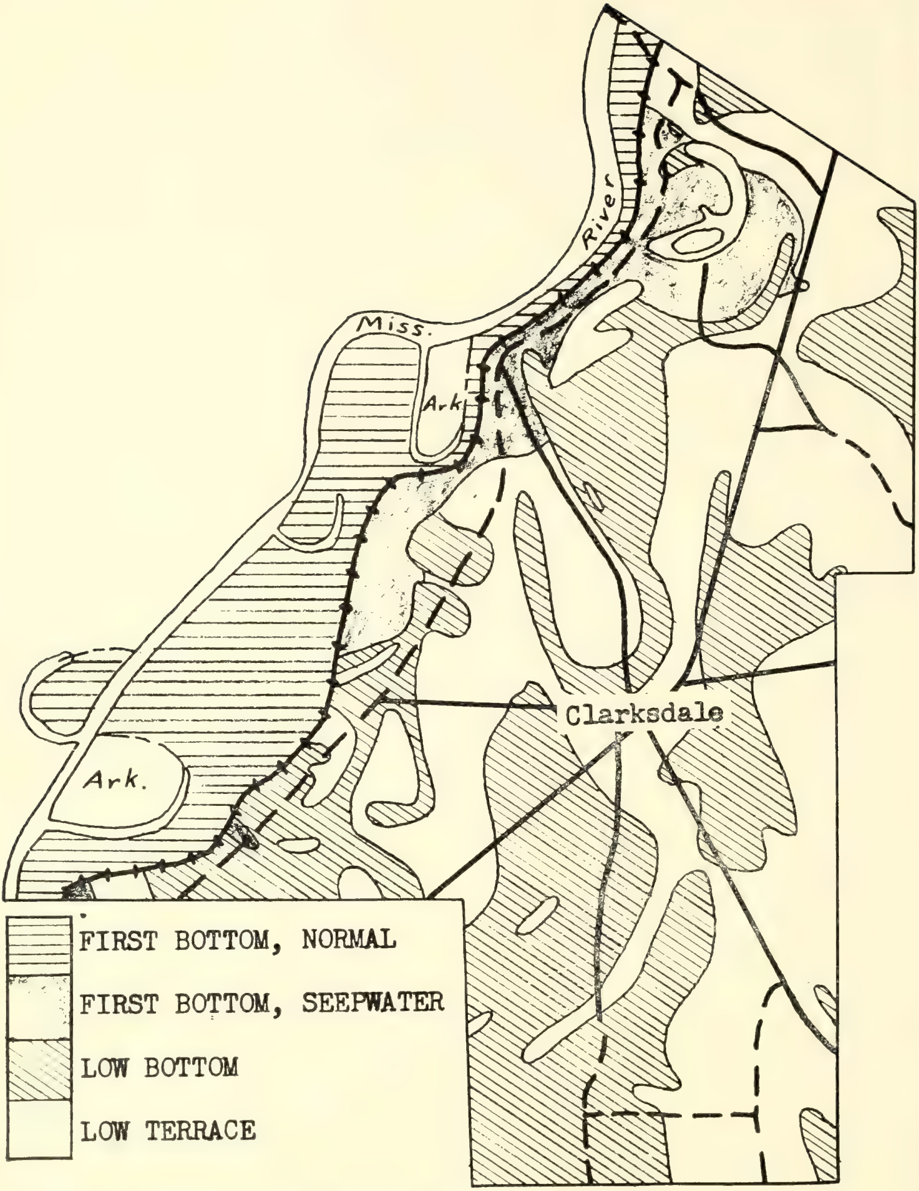

Miss.
River
T
Ark.
Ark.
Clarksdale
FIRST BOTTOM, NORMAL
FIRST BOTTOM, SEEPWATER
LOW BOTTOM
LOW TERRACE

Figure 1. Major Soil Groups of Coahoma County.

COAHOMA COUNTY SOILS

By C. G. MORGAN and H. B. VANDERFORD

This soil report is written primarily for the farmers of Coahoma County. All soils are developed by nature with certain properties and the soil map, made by men trained in scientific soil classification, shows these properties. The recommendations for management and land use are based on field experiments of the Experiment Station, observations and field studies, and the experience of good farmers.

Generally the county can be divided into three major soil groups, see figure 1. (1) First Bottom or the "made land" group of soils occurs in places along the present levee near the recent channels of the Mississippi River. These soils are alkaline or "sweet" soils and are the most productive soils in the county. They make up approximately 10 percent of the total land area in the county. (2) Low Terrace or the "sandy ridge" group of soils occurs on ridges along the old channels of the Mississippi River, Sunflower River, and bayous that make up the natural drainage system of the county. These soils are slightly acid or "sour" and are productive soils adapted to a wide variety of crops. They make up approximately 40 percent of the total land area of the county. (3) The Low Bottom or "buckshot" group of soils occurs in wide flats and on low ridges in the backwater areas. Due to their heavy physical nature these soils are limited in productivity. These soils occupy approximately 50 percent of the total land area in the county. There is a fourth group of soils not shown in figure 1 that occurs within each of the three groups previously mentioned. This is the depressional group of soils which occupies the "low swags" or depressed areas and is subject to frequent overflow from local rain water.

For the farmers and landowners of Coahoma County this report makes suggestions based on the soil conditions shown on the maps concerning secondary drainage, field arrangement, row direction, road and turnrow location. Also the report attempts to answer questions concerning what crops are adapted to each soil type, what treatment each soil type needs and what yields may be expected.

Know Your Soils and Plan Their Management

FIRST EXAMINE THE SOIL MAPS

1. **Note symbols**—The first step in using this report is to examine your soil map and become familiar with the various symbols used to designate certain features found on the land. Listed below are the symbols found on the soil map and their meaning:

A. symbols showing type and phase

436 Soil number which denotes the soil type in the area where the number is placed.

BIL These letters and number following the soil number (example 436 BIL) indicate the slope of the area, the amount of erosion on the area and the land use of the area. The following list shows all the slope ranges, degress of erosion and land use classes shown on the maps.

Slope	Erosion	Land Use
A-O-½%	1 None	L-Cultivated
B-½-3%	2 Slight	F-Woodland
C-3-7%	3 Severe	P-Pasture
D-7-10%		X-Idle
E-over 10%		H-House site

〜	SOIL BOUNDARY, the solid line indicates the place where two different soils come together.
← →	TIE SYMBOL, connects two areas of the same soil type or phase.
— · —	SMALL NATURAL DRAIN
—··—	SHALLOW DUG DITCH
—···—	DEEP DITCH, either dug or natural.
═	RIVER OR WIDE DITCH, either dug or natural,
⬭	LAKE
▨	INTERMITTENT LAKE, dry during a part of the year.
''''''''	VERY STEEP BANK
⁝⁝⁝⁝	ARTIFICIAL LEVEE
⊢⊣ ⊢⊣	GAS LINE
--------	POWER LINE
▬---	PAVED ROAD

▬-	GRAVEL ROAD
———	DIRT ROAD
----	TURN ROW
┼┼┼	RAILROAD
■	TENNANT HOUSE
■	LARGE HOUSE
▬	STORE
✝	CHURCH
⚑	SCHOOL
[+]	CEMETERY
⌒	SAW MILL
▲	INDIAN MOUND
▲	COTTON GIN
— — —	COUNTY LINE
—-—-	STATE LINE
16 12 7	SECTION CORNER AND NUMBERS
∴	SAND BLOW OR SANDY SPOT

Learn the above list of symbols in order that they may be recognized on the soil map.

332°—The ° following the soil number denotes a shallow phase of the 322 soil type; essentially it is a buckshot or heavy clay soil some 18" deep over coarse sand.

B. Symbols showing physical culture.

2. **Note Numbers** and **Names** of **Types**—Each kind of soil mapped within the farm or tract is marked on the map with a certain set of numbers. Each of these numbers has a definite meaning. The first number tells which of the four major groups previously mentioned the soil falls in, the second number refers to the internal drainage conditions of the soil, and the third number refers to the surface texture of the soil (how much sand or clay). For example, an area marked 322 is a soil that falls in the low bottom group, has poor internal characteristics, and has a clay surface. By looking in the "Legend of Soils," page 8 it can be seen that the name of 322 is Sharkey Clay. Where an area is too small to accommodate the soil number, the number is placed adjacent to the area and connected with it by a line.

3. Entire Soil Profile is Important—In studying and classifying soils, the soil must be examined to a depth of 40 inches or more. It frequently happens that two soils may be identical in the surface layer but may differ widely in the subsoil and hence have different agricultural values. It must be clearly understood that the subsoil characteristics of the soil are just as important as the surface characteristics.

Figure 2 shows Dundee silty clay, loam (number 434 on the soil map) to a depth of 40 inches. The surface or plow layer is about 6 inches thick. Beneath the surface is a layer of silty clay some 24 inches thick which slows down internal flow of soil water; however, beneath this layer of silty clay is a layer of silty clay loam to a very fine sandy loam which allows the soil water to pass down readily after it comes through the silty clay layer. This layer of sandier material makes this soil much more desirable for crop growth than it would be if the silty clay layer extended to a depth of 40 inches. Therefore it can be said that the high quality of a soil is due as much to the nature of the deeper layers as to the nature of the surface soil or plow layer.

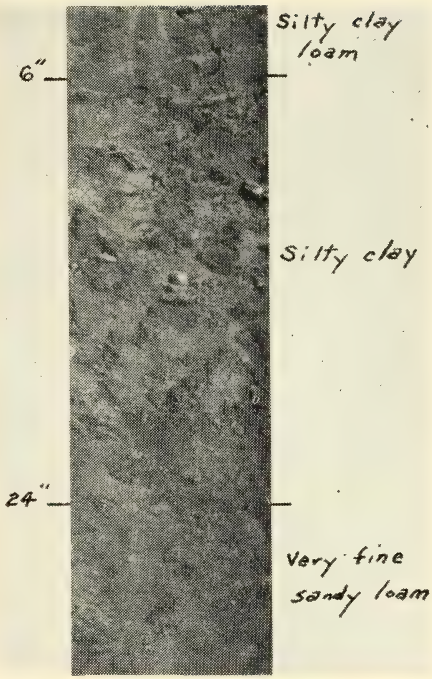


Figure 2. Profile of Dundee silty clay loam showing three different layers. The very fine sandy loam layer beneath the silty clay accounts for good internal flow of water.

4. **Soil Types Vary**—It must be understood that a given soil type has a range of properties. Boundaries separating soil types vary in sharpness. In other words, some soil types may change within a few feet and others may change over a space of 100 to 200 feet. Between most soil types there is a zone in which you find properties common to both types. Also in some areas soil types may be found occurring in such a pattern that separation is not practical. When this condition is found a soil complex is mapped, (shown on the soil maps as 340, 460 ,etc.; the soil

number of a complex always ends with 0). Conditions found within these complexes are described, page 19.

5. **Type Differences Have Definite Causes**—The formation of soil types is not a matter of chance. Their character is determined by a number of factors. (See discussion page 28) All of the soils in Coahoma County are young, due to their alluvial nature. Since their deposition by the Mississippi River the forces of nature, namely, climate, and native vegetation, have not had time to influence them too much, therefore the source of the material deposited and the method of deposition are the factors which have greatly influenced the nature of the Coahoma County soils. A study of the past habits of the Mississippi River is essential to a thorough understanding of these soils, see page 28.

Table 1. Key to Soil Types and Yields Produced on Coahoma County Soils with Good Management.

Soil Type No.	Soil Type Name	Land class	Yield			
			Cotton lbs. lint per acre	Hybrid corn bu. per acre	Soybeans bu. per acre	Oats bu. per acre
123	Mhoon silty clay	3	400	50	40	40
133	Commerce silty clay	2	500	65	40	60
134	Commerce silty clay loam	2	550	90	40	60
135	Commerce silt loam	1	775	120	45	85
136	Commerce very fine sandy loam	1	825	120	45	85
156	Robinsonville very fine sandy loam	1	825	120	45	85
160	Robinsonville-Crevasse complex	1	-----	-----	----	----
170	Crevasse soils	5	-----	-----	----	----
210	Dowling soils	4	350	34	18	25
212	Dowling clay	4	300	34	15	30
235	Souva silt loam	2	600	90	30	60
312	Alligator clay	3	375	45	30	35
313	Alligator silty clay	3	375	45	30	35
322	Sharkey clay	3	375	45	30	35
323	Sharkey silty clay	3	375	45	30	35
324	Sharkey silty clay loam	2	400	50	35	40
325	Sharkey silt loam, overwash	2	500	65	35	60
326	Sharkey very fine sandy loam, overwash ph*	2	500	70	35	60
333	Tunica silty clay	2	475	60	40	60
340	Sharkey-Clack complex	5	-----	-----	----	----
423	Forestdale silty clay	3	375	45	30	35
424	Forestdale silty clay loam	2	400	50	30	35
425	Forestdale silt loam	2	450	60	28	35
426	Forestdale very fine sandy loam	2	460	75	28	40
434	Dundee silty clay loam	2	500	85	40	45
435	Dundee silt loam	1	600	90	45	50
436	Dundee very fine sandy loam	1	800	95	45	55
444	Dubbs silty clay loam	1	750	95	45	70
445	Dubbs silt loam	1	775	100	45	70
446	Dubbs very fine sandy loam	1	825	115	45	80
456	Bosket very fine sandy loam	1	825	120	45	80
457	Bosket fine sandy loam	1	800	90	35	65
460	Clack-Dundee complex	1	-----	-----	----	----
464	Beulah silty clay loam, overwash ph*	1	450	65	20	45
466	Beulah very fine sandy loam	1	475	40	10	20
470	Clack-Bosket complex	5	-----	-----	----	----

*Phase.

COMPARE YOUR YIELDS WITH TEST YIELDS

1. **Use Five-Year Averages**—High crop yields year after year are the result of good management. Low yields may be caused by poor soil, bad management, or by growing unadapted crops.

Table 1 shows what yields can reasonably be expected from Coahoma County soils over a period of five years under good management. Five years are necessary for good results because of wide seasonal variations in rainfall, temperature and insect and disease injury.

2. **How to Get Good Yields**—Practices that bring high yields of cotton will not necessarily bring high yields of soybeans. Some soils will produce higher yields of a specific crop than others. For example, the sandier soils produce more corn than the clay soils. Therefore, the first step in producing high yields is to select crops adapted to your particular soil. Since cotton is the main cash crop for the county, farmers will select their best land for this important crop. However, on the remaining acres the matter of crop adaptation should be studied thoroughly.

Actual production records must be kept to make yield comparisons. Unless you have kept yearly records you are likely to remember the high yields on individual fields and forget the low yields.

Since new crop varieties, new cultural practices and new plant diseases or insect pests may greatly affect yield levels in the future, the figures in Table 1 must be regarded as strictly current yields.

KNOW WHAT GOOD SOIL MANAGEMENT MEANS

The following discussions of soil management is applicable to all soils in Coahoma County. It deals with general principles which are fundamental for efficient use regardless of the type of soil. Specific recommendations for each soil type are given in "Management by Soil Groups" (page 18).

Drainage

Proper drainage is essential for efficient land use on all of the soils in Coahoma County. However, before extensive drainage systems are planned, the productive capacity and crop adaptation of the soil should be considered. In table 1 you can find the yields of various crops that may be expected on all the soils in Coahoma County after drainage and proper management have been used.

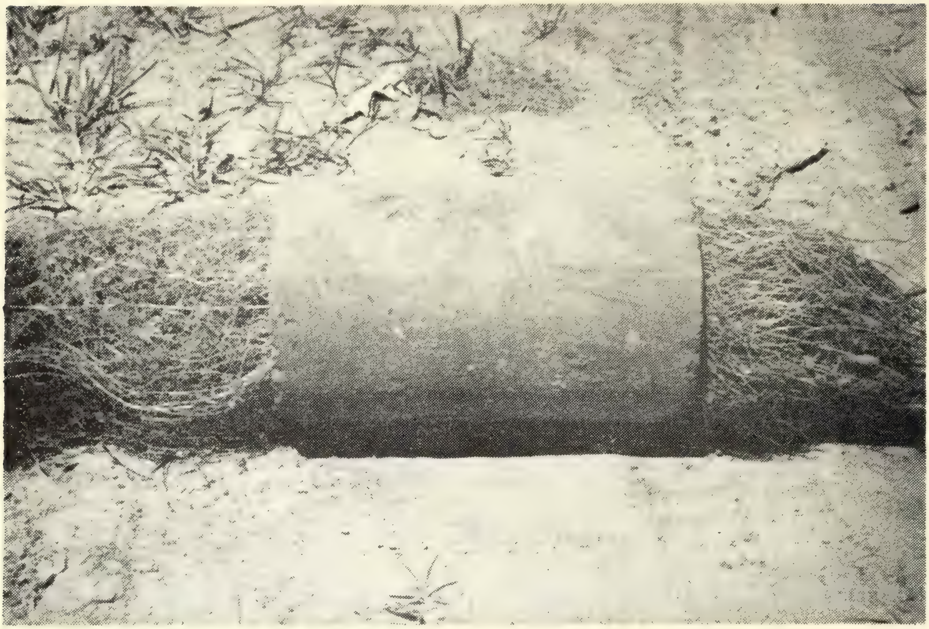
If the soil map is used as a guide, a system of natural surface drainage can be laid out for each farm. Ditches where possible should be located in natural low depressions (on the soil maps these areas or soil types have their soil number beginning with the number 2, example 210 or 212). The type of ditch used should be governed by the size of the watershed area and the soil types occurring within the watershed area. Surface run-off from

Table 2. Corn Yields Obtained By Coahoma County 4-H Club Members[1]

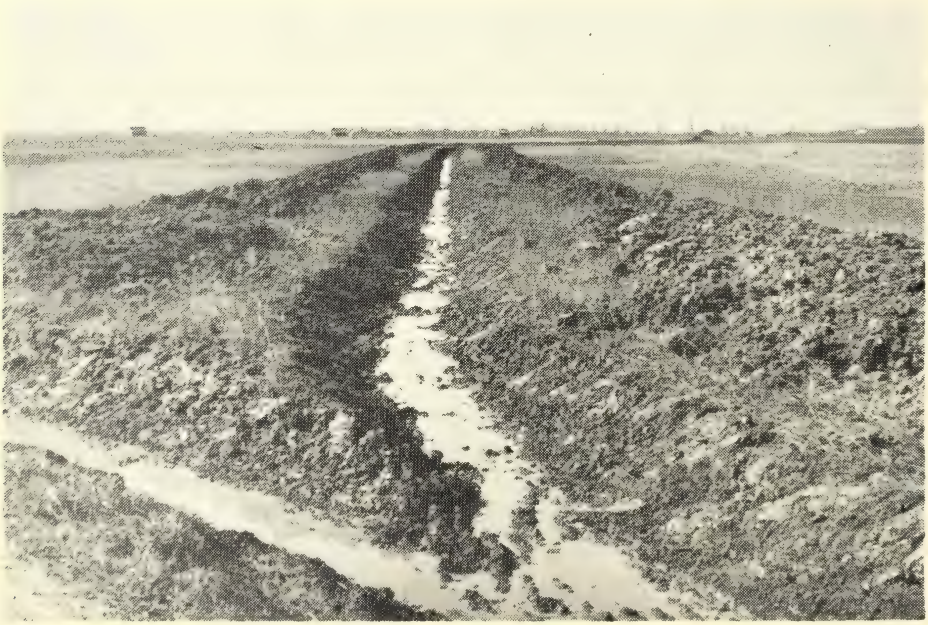
Soil Type		1947		1948		1949		3-Yr. (47-49)
No.	Name	No. of fields[2]	Av. yield bu. per acre	No. of fields[2]	Av. yield bu. per acre	No. of fields[2]	Av. yield bu. per acre	Average bu. per acre
456	Bosket very fine sandy loam	7	114	3	114	4	128	118.6
446	Dubbs very fine sandy loam	3	90	7	127	6	109	118
436	Dundee very fine sandy loam	7	75	5	84	3	106	88.3
434	Dundee silty clay loam	2	79	3	86	5	100	88.3
424	Forestdale silty clay loam	8	77	5	84	4	81	80.6
423	Forestdale silty clay	--	------	1	61	--	------	--------

[1] The tests were planted and harvested under supervision of assistant county agent.

[2] Each field represents one acre or more of corn.



Tile drainage in "delta" generally ends up like this.



Example of a shallow dragline ditch. This picture was taken before the spoil bank was spread.

Steep sandy escarpments like this established to a pasture program for alternate grazing provides palatable, nutritious feed and protects against loss of topsoil.

sandy soils is much less than the run-off from clay soils, therefore on the clay soils more ditches and larger ditches will be required for adequate drainage.

The cutting of ditches across ridges should be avoided except where it is absolutely essential to drain isolated depressions. The omission of cross ditches makes possible longer rows which are essential to mechanized farming.

Field Layout and Row Direction

Where practical field boundaries should be placed on soil boundaries that separate soil types requiring different types of management rotations. Fertilizer treatments, and other management practices that are suitable for the entire field can then be planned.

Where possible, roads and turn rows should serve as field boundaries and should be located on soil boundaries. Roads that cross soil boundaries and fields rather than follow them tend to divide the fields into smaller units unsuited to mechanized farming. The boundaries of soils with C and D slopes, as well as escarpments and bayou banks, are ideal locations for roads.

Row direction in any field should be governed by the following factors: soil type, slope of land and method of tillage. Rows on soil that have A or level slopes should run so as to provide the best possible run-off. On soils where the middle soil number is 1, 2, or 3 and the slope is B, each row should run so that it has slope enough to carry the water that falls on it to a ditch or outlet. On soil types where the middle number is 4, 5, or 6, rows should run on the contour (with the slpoe) so that each row will hold the water that falls on it. The soils just mentioned have a subsoil which allows water to move readily down through the soil. Water should not be allowed to run off of these soils to more poorly drained soils. Rows on all C and D slopes should be run on the contour in order to prevent harmful erosion and to conserve moisture.

Where mechanized methods of tillage are to be used, long rows are more efficient. By following the above suggestions on field layouts and row direction, longer rows and larger units can be had.

Fertilization

Lime—Clovers and most other legumes grow best on soils that have a neutral to slightly acid reaction (soils with such a reaction are generally referred to as "sweet" soils). Soils that are acid or "sour" should receive applications of lime. The amount of lime required to adjust the reaction of a soil to a level favorable for best growth of legumes is determined mainly by two factors. First, the degree of "sourness" in the top soil and second, the texture or "heaviness" of the top soil. For example, a sandy loam soil with the same degree of acidity as a heavy clay soil requires only one-half the amount of lime to accomplish the same results.

The reason for the application of lime is to obtain best growth of inoculated legumes, which, in turn, furnishes an excellent source of organic matter and nitrogen to the soil. See your county agent or other agricultural workers for information on how to sample your soil before sending it to the laboratory at State College for analysis.

Nitrogen and Organic Matter—Nitrogen has long been recognized as the main fertilizer element lacking in all Delta soils. Addition of nitrogen and organic matter to the soil increases the productivity for non-legume crops. The incorporation of organic matter in soils with undesirable physical characteristics (soil types having their numbers ending in 12, 13, 22, and 23) always results in easier tillage and higher yields. Properly inoculated legume crops and manure provide an excellent source of both nitrogen and organic matter. Crop residues plowed under are also very important in keeping the soil in a good mellow condition and in increasing the rate at which it will absorb water. Bur clover and vetch are well adapted winter legumes for the sandy soils (soils having 5, 6 and 7 as their last number). Vetch and winter peas are both adapted on the clay soils (soils having 2, 3, and 4 as their last number). Growing winter legumes on clay soils to be turned under in the spring is very hazardous; therefore, a rotation whereby summer legumes such as soybeans are grown for nitrogen and organic matter is more desirable. Where it is not practical to grow leguminous crops, commercial nitrogenous fertilizers must be used on all non-legume crops if maximum yields are to be obtained. Where a heavy leguminous crop has been turned under, additions of large amounts of commercial nitrogenous fertilizer may cause excessive stalk growth in cotton and lower yields may result. Depressional areas and first bottoms that receive frequent overflows maintain a higher nitrogen level and do not require additions of large amounts from commercial sources. In fields where small depressions are numerous more efficient use of nitrogenous fertilizer can be had by leaving the fertilizer off the rows that occur in the depressions and using it on the ridges.

Phosphorus and Potassium—Experimental work with phosphorus and potassium fertilizer on most "Delta" soils has shown very little need for these minerals. This does not mean that in years to come "Delta" soils will not be depleted of their phosphorus and potassium supply. The sediments from which the soils in Coahoma County and most of the Delta were formed were rich in these minerals and the past history of a continuous cotton type of farming has removed very little of these elements. With a change in the type of agriculture in which more hay and grain crops are grown, these elements will be taken out of the soil much faster. These deficiencies should first show up in the soils of the Low Terrace group (soils having their number beginning with 4) and it is on these soils that the farmer should watch for deficiency symptoms and reduced yields in his crops. After noticing these conditions, the farmer should then use all available facilities to determine his particular needs. In many cases reduced yields are caused by the poor physical condition of the soil. This condition must be corrected before crops can make efficient use of the available fertilizer.

Proper soil analysis can serve as a very good indicator of soil fertility; therefore, the farmer can have his soil tested in the laboratory and use this information for further studies in his fields. If the test shows his soil to be low in phosphorus and potassium and the yields have been getting lower over a period of years, he should then select 10 or 15 rows in the field or a small plot if in a pasture and apply the phosphorus and potassium at the rates recommended being sure to leave 10 or 15 rows or a plot on which phosphorus and potassium were not applied. The yields on these two plots should be carefully measured and calculated on a dollar and cent basis. After such a comparison the farmer is then in a position to decide whether or not he should use phosphorus and potassium fertilizers. The county agent or other agricultural workers in the county should be consulted concerning such matters.

The following fertilizer recommendations, winter legume, and pasture recommendations (tables 3, 4) were made by the Delta Branch Experiment Station, Stoneville, Mississippi:

COTTON

1. Apply 60 pounds of nitrogen per acre except where winter legumes have been turned under.

2. Where a good growth of winter legumes is turned under, no additional nitrogen is needed. If poor stand or a poor growth prevails, commercial nitrogen should be applied accordingly.

3. Apply nitrogen prior to planting or as an early side dressing. Pre-planting application has given slightly better results.

4. If nitrogen is to be applied as a side dressing, make application immediately after cotton is cleaned out the first time.

5. Apply anhydrous ammonia 6 to 8 inches deep on sandy loam soils and 5 to 6 inches deep, or as deep as conditions will permit, on buckshot soils. It must be

Table 3. Winter legume recommendations for cotton production, 1949, Yazoo-Mississippi Delta, Delta Branch Experiment Station

Legumes	Rates of seeding per acre	Dates of seeding
Recommended:		
Giant bur clover	10-15 bushels, unhulled	Last of July or first of August
Wild winter peas	50-60 pounds	August
Hairy vetch	30 pounds	September 15 to October 15
Austrian winter peas[1]	45 to 50 pounds	September 15 to October 15
Not recommended but if planted:		
Dixie wonder peas	60 pounds per acre	November 15 to December 1
Willamette, vetch	35 to 40 pounds per acre	September 15 to October 15
California bur clover	10 to 15 pounds of cleaned seed	August

[1] Austrian winter peas should not be planted on land where more than two previous crops have been turned under.

All winter legume seed, except bur clovers, should be well covered when planted. Bur clover may be sowed on the surface and left uncovered or they may be covered lightly at the last cultivation.

The optimum date for turning under winter legumes will depend upon the amount of growth produced. Normally, they should be turned under about April 1. Two or three weeks should elapse before planting.

Table 4. Guide to Delta Pasture Feed-Crop Production

Kind of pasture	Recommended varieties	Rate of seeding per acre	Fertilizer	Type of soils preferred	Time of planting	Approximate grazing season
Alfalfa	Buffalo Kansas Common Okla. Common	10-20 lbs.	Test soil for lime, phosphorus, and potash	Well drained Class 1 & 2	Oct. 1-15	3-5 cuttings of hay
Bermuda grass	---------------	5 lbs.	---------------	All types	Mar. 1-Apr. 1	June 1-Nov. 1
Dallas grass	---------------	10 lbs.	30 lbs. nitrogen if soil is poor	Mixed or heavy clay Class 2 & 3	Oct. 1-Nov. 1	May 15-Nov. 1
Fescue	Kentucky 31	10 lbs. alone 5-10 lbs. with clover	30 lbs. nitrogen at planting; 60 lbs. for winter grazing	Heavy clay Class 3	Oct. 1-Nov. 1	Oct. 15-July 1
Red clover	Kenland Cumberland	10-15 lbs. seed alone or in oats	Test soil for lime, phosphorus and potash	Mixed or heavy clay Class 2 & 3	Oct. 1-Nov. 1	Mar. 1-Aug. 1 2-3 cuttings of hay
Ladino clover	Seed in oats	1-2 lbs. seed in oats	Test soil	Heavy clay Class 3	Oct. 1-Nov. 1	Oct. 1-July 1
White clover	Seed in oats	2-4 lbs. seed in oats	Test soil	Heavy clay Class 3	Oct. 1-Nov. 1	Mar. 1-July 1
Crimson clover	Hard seeded for volunteer crops	12-15 lbs.	Test soil for lime, phosphorus and potash	All types	Oct. 1-Nov. 1	Jan. 1-May 15
Sudan grass	Sweet Tift	6-10 lbs. in 38" to 40" rows	60 lbs. nitrogen	Sandy loam Class 1	June 1-20	July 15--Oct. 15
Persian clover	Not recommended	---------------	---------------	---------------	---------------	---------------
Hop clover	Not recommended	---------------	---------------	---------------	---------------	---------------
Lespedeza	Korean	20-25 lbs. seed in oats	---------------	Sandy loam Class 1	Feb. 15-Mar. 15	July 1-Oct. 1
Grain sorghum	Martin	4-10 lbs in 38" to 40" rows	30-45 lbs. nitrogen	Sandy loam Class 1	June 1-July 1	Hog off in Sept. or Oct.
Ooats	Delta Red-late Nortex-late Delair-early	3 bu.	60 lbs. in Sept. for winter grazing; 30 lbs. in Feb. for grain	Sandy loam Class 1	Sept. 1- Nov. 1	Nov. 1-Mar. 1
Ryegrass	---------------	25-30 lbs.	---------------	---------------	Sept. 1-15	Jan. 15-June 1

sealed in the soil. Apply solid materials as deep as practical with available equipment.

6. Apply phosphate and potash on a trial basis only, except where beneficial effect has been established. Have soils analyzed to indicate need for trials.

CORN

1. Apply 90 to 120 pounds of nitrogen per acre.

2. Place nitrogen as deep as practical with available equipment—a depth of 6" is desirable.

3. Apply nitrogen prior to planting or as an early side dressing—applying nitrogen before planting will save at least one cultivation.

4. Leave 12,000 corn plants per acre. If corn is planted in checks, leave three stalks per hill, or if corn is drilled, leave corn spaced about 15 inches apart.

OATS

1. For grain—apply 30 to 40 pounds of nitrogen per acre as a top dressing during the latter part of February or in the first half of March.

2. For grazing—apply 60 pounds of nitrogen per acre prior to planting and 30 to 40 pounds per acre about March 1 as a top dressing.

SOYBEANS

Use no fertilizer except on a trial basis or where beneficial effect has been established.

GRAIN SORGHUM

Apply 30 to 40 pounds of nitrogen prior to planting.

SUDAN GRASS

Apply 60 pounds of nitrogen before planting.

What Is The Type of Cropping System for Your Soil—In determining the best cropping system for a given farm the soil types, ease of draining, adapted crops and workability must be considered. All cropping systems should be planned to maintain the most efficient production of adapted crops on a permanent basis.

Since cotton is considered the principal cash crop, it is given the most favorable position in the cropping systems for soils where it is adapted. The sandier well-drained soils are capable of producing high yields of cotton yearly whereas the heavier clay soils should be placed in a rotation whereby cotton would be grown every other year or following two years of another crop such as soybeans.

The class of each soil type and the cropping system for all classes are listed in table 5. A complete discussion of management for each soil class is given under "Management by Soil Group" beginning on page 18.

KNOW THE SPECIFIC PROBLEMS OF YOUR SOILS

Study your soil map and identify all of the soil types occurring on your farm. Know how many acres of each type are on your farm and, after reading the chapters on general soil management, study the difference in your soils. By reading the land class descriptions and the management practices suggested for each group, the weaknesses in your present management can be found and necessary changes can be made. The way the land has been cropped and managed in the past, together with the soil type and your future desires, will determine your farm plans.

One of the main obstacles to the proper farm layout in Coahoma County is the custom of cutting fields up into 40-acre blocks and running turn rows and ditches in straight lines. Use soil boundaries for field boundaries where possible and avoid cutting ditches across ridges. Always place secondary drainage ditches in the natural low swags or depressions. Many fields in Coahoma County have two or more soils with widely

Table 5. Cropping systems suggested for Coahoma County soils.

Soil Group	Soil No.	Soil Type Name	Year	Cropping Systems		
				Cotton (as often as possible)	Cotton & Grain	Hay, Pasture or Grain
1 (35% of total land area)	135 136 156 160 235 435 436 444 445 446 456 457 464 466 460	Commerce silt loam Commerce vfsl Robinsonville vfsl Robinsonville-Crevasse complex Souva silt loam Dundee silt loam Dundee vfsl Dubbs silty clay loam Dubbs silt loam Dubbs vfsl Bosket vfsl Bosket fsl Beulah silty clay loam Beulah vfsl Clack-Dundee complex	1	Continuous Cotton (plant vetch or bur clover)	Cotton (plant bur clover in fall)	Rye Grass and white clover
			2	"	Bur clover seed (corn)	"
			3	"	Cotton (plant bur clover)	"
			4	"	Bur Clover seed (corn)	"
			5	"		
			6	"		
2 (6% of total land area)	133 134 333 434	Commerce silty clay Commerce silty clay loam Tunica silty clay Dundee silty clay loam	1	Continuous Cotton (plant vetch in fall)	Soybeans (for oil)	Fallow (plant alfalfa in fall)
			2	"	Cotton	Alfalfa
			3	"	Soybean (for oil)	" "
			4		Cotton	"
3 (3% of total land area)	325 326 425 426	Sharkey silt loam, overwash Sharkey vfsl, overwash Forestdale silt loam Forestdale vfsl	1	Cotton (Plant vetch or bur clover)	Corn	Lespedeza
			2	Cotton	Soybeans (for oil)	Lespedeza
			3	Soybeans (for oil or turn under)	Cotton (plant vetch or bur clover)	Corn
			4	Cotton (plant vetch or bur cl.)	Corn	Lespedeza

4 (10% of total land area)	324 424	Sharkey silty clay loam Forestdale silty clay loam	1	Cotton (winter peas)	Soybeans (for oil)	Oats and red clover
			2	Winter Peas for seed and fallow)	Soybeans (for oil)	Red Clover
			3	Cotton	Cotton	Corn
			4	Cotton (winter peas)	Soybeans (for oil)	Oats and red clover
			5		Soybeans (for oil)	Red Clover
5 (40% of total land area)	123 312 313 322 323 423	Mhoon silty clay Alligator clay* Alligator silty clay Sharkey clay Sharkey silty clay Forestdale silty clay	1	Cotton (winter peas	Cotton	Corn (plant oats in fall)
			2	Winter peas for seed and fallow	Soybeans (for oil)	Oats (plant fescue and ladino in fall) Fescue and ladino
			3	Cotton (winter peas)	Soybeans (for oil)	Fescue and ladino
			4			Cotton
			5		Cotton	Corn (plant oats in fall)
6 (5% of total land area)	210 212	Dowling soils Dowling clay		Follow same rotations suggested for management class 3 after adequate drainage has been provided.		
7 (1% of total land area)	170 340 470	Crevasse soils Sharkey-Clack complex Clack-Bosket complex		Best adapted to drouth resistant hay, pasture crops, and winter grazing.		

*Note—Alligator clay on most of the maps will have the number 312, however, on some previous mapping the number 422 was used to denote this soil. Where the number 422 appears on the soil map remember its correct number is 312.

varying characteristics requiring different types of crops and management. When the area of one soil is very small it is often necessary to farm it the same way as the major type or types. Where the area of different types is large enough, each can be managed separately and devoted to its best permanent use.

Soils Groups of Coahoma County, Their Use and Management

GROUP I.

The soils of this group are listed in table 5 with suggested cropping systems. All of the soils in this group are very fertile, the most productive soils in the county. They are well-drained to fairly well-drained with sandy surfaces and subsoils which allow water to move down. They occur on nearly level to moderate slopes with the greatest percentage occurring on gently sloping topography. These soils are well adapted to all general crops, pasture grasses and legumes and high yields of all these crops can be maintained over long periods with good management. Since the subsoil of these soils is open or "porous" little artificial drainage in the form of ditches is necessary.

Where these soils do occur on level to nearly level slopes, a system of W-type ditches will furnish ample surface drainage. In areas where they occur on moderately sloping topography, contour cultivation is essential for preventing loss of topsoil and conserving moisture.

High yields of cotton and corn can be maintained if fertilizer recommendations are followed. Where winter legumes have been turned under a small amount of nitrogen from some commercial source must be added to maintain high yields. Experiment Station tests show that a heavy winter cover crop such as hairy vetch or bur clover supplies approximately 40 to 50 pounds of actual nitrogen to the soil.

Before alfalfa or clovers are seeded on these soils, test your field for mineral deficiencies and fertilize accordingly.

This soil group occupies approximately 35 percent of the total land area in the county.

GROUP II.

The soils of this group are listed in table 5 with suggested cropping systems. These soils are very fertile and highly productive. They differ from the soils of Group I in that they have rather heavy texture surfaces or plow layers.

These soils are fairly well drained internally but require more artificial drainage than do the soils of Group I. They generally occur on ridges or rolling topography. Where these soils are cultivated on moderate slopes the rows should always follow the ridge. On steeper slopes they should not be cultivated.

These soils are excellent cotton soils and are well adapted to the growth of alfalfa, hay and small grain. Approximately 6 percent of the total land area of the county falls in this group.

GROUP III.

The soils of this group are listed in table 5 with suggested cropping systems. These soils are less fertile than Groups 1 and 2 and are limited in productivity due to poor internal drainage. This group of soil is commonly called "post oak" land.

The subsoil of these soils which is high in silt content retards the downward movement of rainwater. The increased amount of surface runoff must be taken care of through extensive artificial drainage ditches in the associated depressions. The surface soil or plow layer is sandy which gives an adavntage in easy tillage. They generally occur on gently sloping to level topography. Where level, an intensive system of W-ditches is necessary for adequate drainage. Winter legumes or summer legumes which provide organic matter annually, should be included in the cropping system of these soils.

These soils are fairly well adapted to cotton and corn and are excellent for pasture and lespedeza. Approximately 3 percent of the total land area of the county falls in this group.

GROUP IV.

The soils of this group are listed in table 5 with suggested cropping systems. Poor internal drainage limits their productivity and makes management more difficult.

The subsoil of these soils is high in silt and clay content which slows down the movement of water through the soil. Rainwater must be taken off the surface by W-type and V-type ditches. A rotation, whereby summer legumes such as soybeans are used one-half of the time, should be included in the cropping system for this group of soils.

Organic matter is essential to keeping the soils of this group in a good state of productivity.

These soils are fairly well adapted to cotton and are well adapted to soybeans. lespedeza and pasture. Approximately 10 percent of the total land area of the county falls in this group.

GROUP V.

The soils of this group are listed in table 5 with suggested cropping systems. These soils are very fertile but are greatly limited in productivity by undesirable physical characteristics. The subsoils in all of these soils are clays and silty clays which allow very little movement of water down through the soil. This "heaviness" in the subsoil makes it necessary to provide extensive drainage systems to adequately take care of the greater runoff occurring on this group of soils. The surface of these soils are heavy (clays and silty clays) which makes land preparation difficult. Best results are generally obtained when the soils of this class are plowed in the fall. The growing of winter legumes for green manure on these soils is very hazardous since it requires the land to be plowed in the spring. Where these soils occur on moderate to steep slope contour cultivation and a rotation which keeps two-thirds of the land in close growing crops is very helpful in preventing loss of topsoil.

These soils are fairly well adapted to cotton and average annual yields of 3/4 of a bale per acre can be expected over a five-year period. In certain years especially when the early spring is exceptionally wet it is very hard to secure a good stand of cotton. Corn yields of 40 to 50 bushels per acre can be expected on these soils under proper management. These soils are well adapted to soybeans and small grains. Alfalfa does well where excellent surface drainage is provided. Of the total land area in the county these soils comprise approximately 40 percent.

GROUP VI.

The soils of this group are listed in table 5 with suggested cropping system. These soils occupy the depressional areas or "low swags" and due to this position receive frequent overflows. They are very poorly drained in their natural state and must be artificially drained before cultivation can be practiced. The location of these soils in the natural low swags and depressions make them invaluable as guides for locating secondary and primary drainage ditches and canals. After these soils have been properly drained, the cropping systems and recommendations made for Group III will apply. If these areas are not adequately drained, they should be used for temporary pastures or to provide temporary grazing during the dry period of the year. Of the total land area in the county these soils occupy approximately 5 percent.

GROUP VII

In table 5 the soils of this group are listed with suggestions for cropping. These soils vary widely in their characteristics; in fact, so widely that only very general suggestions concerning them can be made. For convenience in discussing their use, three groups (called soil complexes) have been set up. The first group denoted on the map by the number 170 is the sandiest, most droughty group and should not be put in cultivation. It is best suited to drought resistant hay and pasture crops or winter grazing. The second group, denoted by the number 340, ranges in character from a poorly drained clay to an excesively drained sand. If the clay soils predominate the area in which this group is mapped, the suggestions given for Group III can be followed. If, however, the droughty sands predominate drouth resistant hay and pasture crops should be used. The third group number 470 ranges from fairly well-drained sandy soils to excessively drained sandy soils. If, in the areas mapped 470 the fairly drained to well drained soils predominate the area, suggestions made for Group I land will apply. If however, the excessively drained sandy soils predominate, follow the same suggestions as for 170.

This group of soils is commonly known as "sand blows" and comprise approximately one percent of the total land area in the county.

Make Your Own Farm Plan and Get the Most from Your Land

Farmers in the county who operate most profitably are those who have studied their soil conditions and have developed definite farm plans. The following part of this bulletin is written primarily for the farmers who are interested in studying their soil maps and developing on their farms logical and profitable farm plans.

The soil map is the farmer's inventory of his land, and from it he can figure just about what each cut of land on his farm is capable of producing. Also, the soil map can be used as a guide for laying out drainage ditches, locating turn rows and houses, laying out permanent fields, and determining row direction.

To illustrate the use of the soil map in sound farm planning, two small farms of approximately 80 acres each with decidedly different types of land have been selected. The soil maps of these two farms are shown in figures 3 and 6.

In Coahoma County or any other county in the Mississippi "Delta" the first consideration in developing a sound farm plan is that of farm drainage. Farm drainage consists of two parts, mainly, secondary drainage and primary drainage. What does the soil map tell the farmer about his secondary and primary drainage problems? Examine the soil maps on pages 21 and 23, figures 3 and 6. The major soil types on the map in figure 3 are shown by the number 446, 436 and 435. The middle number (446, 436 and 435) indicate that these soils have sandy subsoils which allow a fairly large amount of water to move down through the soil. This means that much of the rainfall passes down through the soil thus, leaving less water to be carried off the surface of the land. The major soil types on the map in figure 6 are shown by the numbers 424, 312 and 212. The middle numbers (424, 312 and 212) indicate that the subsoil of these soil types are silty clays and clays which allow very little water to pass down through the soil. On these heavy soils nearly all rainwater has to be carried off the surface of the land. First then the soil map has given the farmer an estimate of the surface run off, that is, how much water he has to get rid of.

Rainwater always collects in the low swags or natural depressions. Examine the two soil maps in figures 3 and 6. Note all the soil types on each map having numbers beginning with 2. Any area in which the soil number begins with a 2 is a low swag or natural depression. The areas make up the natural drainage pattern for any farm and drainage ditches should always be placed in them for best results. Avoid cutting drainage ditches across ridges except where it is necessary to drain isolated depressions. Second, then, the soil map tells the farmer where his drainage ditches should be located.

As previously mentioned farm drainage is made up of primary and secondary drainage. Primary drainage is either natural or artificial. Nature's primary drainage is in the form of streams and bayous. Artificial primary drainage is provided through the digging of deep dragline ditches. Examine the two soil maps figure 3 and 6 again. In figure 3 along the bottom boundary of the soil map, notice Cassidy Bayou. This is an example of natural primary drainage. In figure 6 artificial primary is seen in the form of a deep dragline canal which is shown on the map by the symbol—...—. Thirdly, the soil map shows whether or not primary drainage is provided within the farm boundary. (Note: In figure 3 notice that this farm is lacking in primary drainage even though Cassidy Bayou makes up its southern boundary.) Secondary drainage is provided generally in the form of W-type ditches or backbone ditches, V-type ditches, and shallow dragline ditches. As previously mentioned all secondary drainage ditches should be placed in the natural depressions or low swags. The choice of the type of ditch to be dug for secondary drainage is governed by three things, namely, the size of the watershed, the soil types occurring within the watershed, and the slope and elevation of the land within the watershed.

Establish the elevation of all the natural low swags and be sure that these areas are higher in elevation than the elevation of the primary drainage outlet. If, however, it is evident that there is ample fall to the primary outlet many W-type

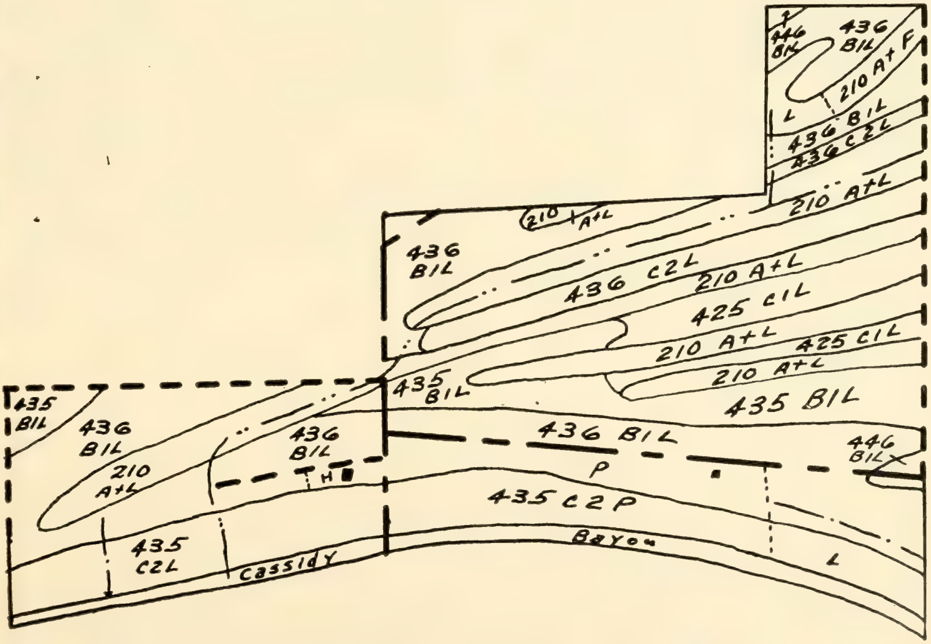


Figure 3. Soil map of an 80-acre Low Terrace or "Sandy Ridge" farm.

ditches may be laid out without the use of instruments. For specifications on W-type ditches consult the PMA office in Clarksdale. Examine the soil maps in figure 3 and 6 again and notice how many secondary ditches and what type of secondary ditches are present on these particular farms. Ditches are shown by symbols (see list of symbols page 6). Lastly, the soil maps show the amount of secondary drainage provided on the farm.

Figures 4 and 7 show drainage maps of the two sample farms with proposed road and house locations. All ditches have been numbered and can be referred to by number by the farmer. Ditch number 1 in figure 4 is a dragline ditch, ditches number 3, 4 and 8 are V-type ditches and ditches number 2, 5, 6 and 7 are W-type ditches. The primary outlet for all the secondary drainage on this farm is on the neighbor's farm to the east. In many cases a joint primary drainage program between several farms is the most efficient and most practical way of providing such drainage. In figure 4 then a very simple farm drainage system is adequate due to the prevailing soil conditions and lay of the land on this farm. The farm drainage for the second farm, is shown in figure 7. On this farm where soil conditions and lay of the land is not too good, a more extensive farm drainage system is necessary. Ditches number 1, 2, 6 and 15 are dragline ditches, ditch number 13 is a V-type ditch, and ditches number 3, 4, 5, 7, 8, 9, 10, 11, 12 and 14 are W-type ditches. As seen, the farm drainage system here has more ditches, large and small, than the farm previously mentioned. The soil map was used as a guide in laying out the drainage system on each of these farms and your farm drainage can be planned in the same manner.

In figures 4 and 7 notice that changes in farm road, turn row and tenant house location have been proposed for these two

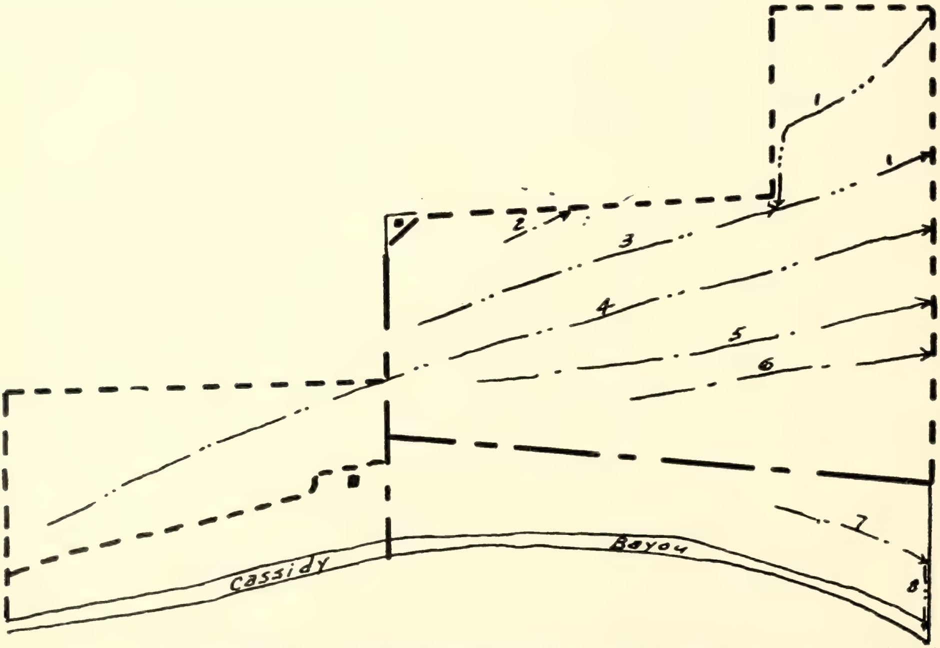
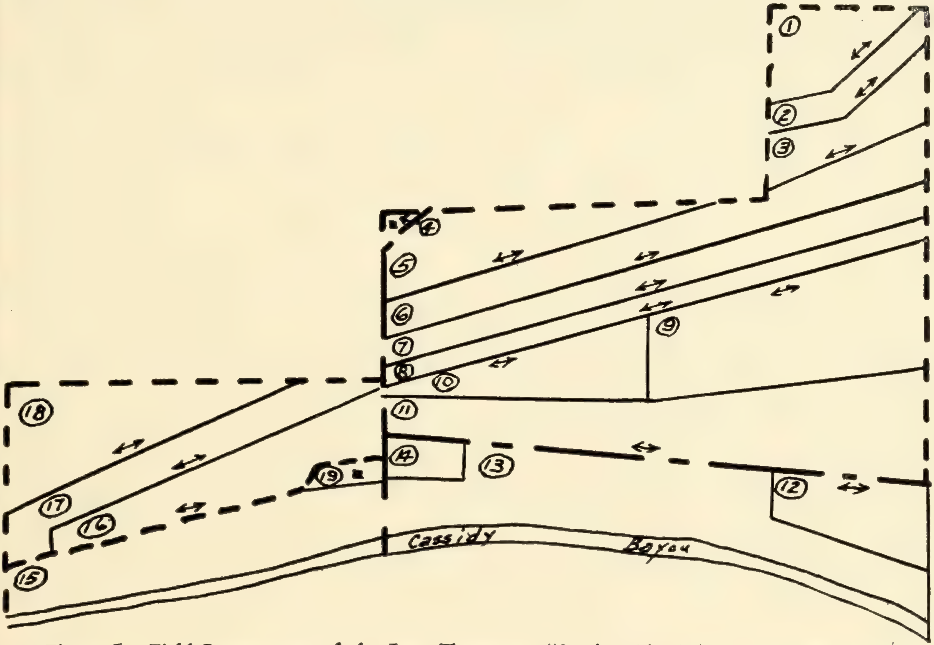


Figure 4. Farm drainage map of the Low Terrace or "Sandy Ridge" farm with road and house location.

farms. The soil map again can serve as an invaluable guide in locating roads and houses. Farm boundaries are always good locations for farm roads. Soil boundaries, especially where soils on steep slopes have been separated are good locations for roads, see farm road west of house in figure 4. In many cases where main county roads have been established, these rules cannot be followed. Ditch banks as in figure 7 make good field road locations. Tenant houses should be located in the corners of fields where they least affect normal operations required in working the land. Houses in the middle of large fields should be eliminated if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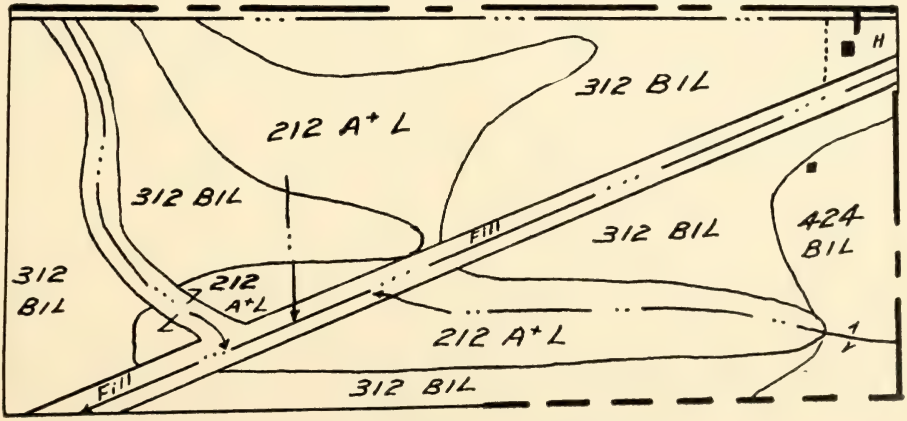
Cassidy
Bayou

Figure 5. Field Layout map of the Low Terrace or "Sandy Ridge" farm with row directions indicated.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312 B1L
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312 B1L
212 A+L
212 A+ L
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Fill
312 B1L

Figure 6. Soil map of an 80-acre Low Bottom or "Buckshot" farm.

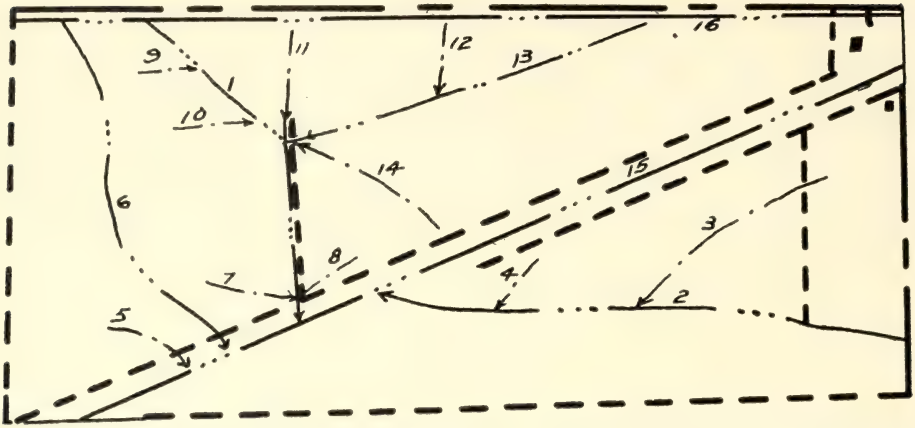


Figure 7. Farm drainage map of the Low Bottom or “Buckshot” farm with road and house location.

mechanized farming is contemplated.

The farms are now drained and are ready for the fields and cuts to be laid out. Here again the soil map serves as the guide. Soil boundaries that separate soils having different crop adaptations should always serve as field boundaries. Figures 5 and 8 show field layout maps for the two illustrated farms. Field boundaries have been drawn and each field numbered in order that the farmer may keep records on each field or cut. After these permanent field boundaries have been established each field can be measured and the exact number of acres determined. The soil map shows the soil types occurring in each field. After studying his soil map and reading the first part of this bulletin the farmer is then in a position to know what crops are best adapted to each of his fields. With these facts in mind he can then decide on his farming program. Since cotton is the principal cash crop for the county, it is always given preference in the cropping system. In tables 6 and 7 the cropping systems selected by these two farms are shown. Table 6 refers to the field layout map in figure 5 and table 7 refers to the field layout map in figure 8.

Examination of table 6 shows what fields were selected for cotton and what other crops were selected for the other fields. This farmer is interested in livestock and the cropping system outline is balanced against the number of livestock he anticipates handling. Note that an all-year pasture program has been planned. Also note that this cropping system is planned for five years and seeding and fertilizer recommendations have been made for each field. Examination of table 8 shows cropping system for the “buckshot’ farm. This farmer was also interested in a livestock program in connection with cotton. Now that the farm is properly drained all fields are adapted to practically the same crops. This is true of most all buckshot farms after proper drainage. Here the cropping system is based on a set of crop rotations which keep the soil well supplied with organic matter.

Table 8 outlines the rotations set up on this farm. These rotations are also balanced against the anticipated number of livestock and cotton allotment. Note that on one side of the farm a 3-year rotation is selected and on the other side a 4-year rotation is selected. Also, on this farm an all year pasture program is proposed.

In developing these farm plans first the farms were drained and turn rows and house located. Then permanent field boundaries were set up and the cropping systems selected. The next step in developing a sound farm plan is the matter of row direction. This is a very important part of the plan and if overlooked can upset the entire farming operation. On the field layout maps in figures 5 and 8 row direction for each of the fields to be put in row crops is indicated with a symbol. Row direction is determined by the soil type and slope of the land. Since the soil map shows both of these factors it again serves as a valuable guide in determining row direction. The soil map of the farm shown in figure 3 indicates as stated before that most of the soils on this farm are capable of absorbing considerable quantities of water, therefore, rows should run so as to hold as much water as possible. Naturally, this means they should run with the ridges or on the contour. Water should never be allowed to drain from a sandy land with good internal drainage on to land with poor internal drainage. The rows on the "buckshot" farm should run so that each row carries off the water that falls in it. Figure 8 has row direction indicated for the buckshot farm.

Fertilizer and seed requirement for each field is the final step in farm planning. The amount and kind of fertilizer to be used in a particular field is determined by three things, namely, crop to be grown, past history of the field and soil type or types occurring within the field. If the farmer does not know what type and how much fertilizer he should use in a particular field it is recommended that he follow the suggestions already mentioned on page 12. For seeding recommendations consult the County Agent or any other agricultural worker.

Every farmer in the county can have farm plans such as these if he studies and understands the soil conditions found on his farm. Soil Conservation Service, Extension Service and Experiment Station personnel in the county can help in making such plans and should be consulted. The two sample farm plans used in the above study were made by the combined efforts of local personnel employed by the Soil Conservation Service, Farm Home Administration, Extension Service, Production Marketing Association and Agricultural Experiment Station.

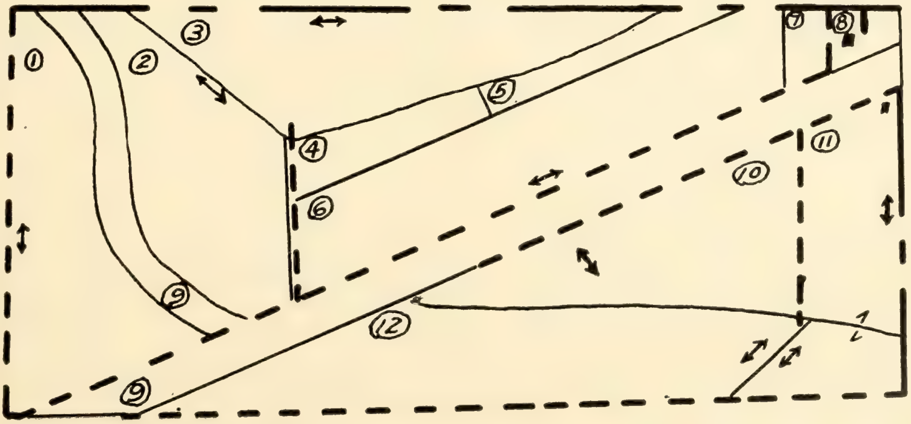


Figure 8. Field layout map of the Low Bottom or "Buckshot" farm with row direction indicated.

Table 6. Cropping Calendar: Seeding and Fertilizer Recommendations

Field No.	Acres	1950	1951	1952	1953	1954	Seeding Recommended	Fertilizer Recommended
1 3 5 7 11 18 20	3.12 2.02 4.88 4.38 8.16 5.71 4.91	Cotton Followed by Bur Clover	Continue				Cotton—1 bu. per ac. Bur Clover—10 bu. unhulled seed per ac. in September	Cotton—30 lbs. Nitrogen and Bur Clover each year. Bur Clover—Seed patch in 1949 in Field No. 1
2 6 8	1.75 5.07 3.12	Corn	Soybeans	Corn	Soybeans	Corn	Corn—14 in. apart. Soybeans—Broadcast 1½ bu. per ac.	Corn—120 lbs. Nitrogen per ac. Soybeans—No fertilizer
9	9.26	Soybeans	Corn	Soybeans	Corn	Soybeans		
4 19	.27 .50	Proposed House-site Homestead						
10	3:40	Oats (Sudan)	Oats (Lespedeza)	Oats (Sudan)	Oats (Lespedeza)	Oats (Sudan)	Oats—4 bu. per ac. Lespedeza—30 lbs. per ac. Sudan 40 lbs. per ac.	Oats—30 lbs. Nitrogen at planting. 40 lbs. Nitrogn top dressing. Lespedeza—1000 lbs. Basic Slag. (Trial basis) Sudan—30 lbs. Nitrogen per ac.
12	3.16	Oats (Lespedeza)	Oats (Sudan)	Oats (Lespedeza)	Oats (Sudan)	Oats (Lespedeza)		
17	3.39	Red Clover (Oats)	Red Clover (Oats)	Red Clover (Oats)	Red Clover (Oats)	Red Clover (Oats)	Red Clover—15 lbs. per ac.	
15	5.75	(White Dutch Clover) (Ky-31 Fescue) Dallas Grass	(Dallas Grass) (Lespedeza)		Continue Continue		White Dutch Clover—Established Ky-31 Fescue—Drill 15 lbs. per ac. in October Dallas Grass—Drill 15 lbs. per ac. in March 1950. Lespedeza—Broadcast 20 lbs. per ac. in March 1951.	Pasture—1000 lbs. Basic Slag per ac. prior to planting, 100 lbs. of Muriate of Potash on 1 ac. in each pasture as a test plot.
14	2	Truck Crops	Continue				See Home Demonstration Agent	1000 lbs. of 0-16-10 per ac. Side dress with nitrogen as needed.
Cassidy Bayou	2.97 2.44	Wildlife Wildlife	Continue Continue				Allow natural vegetation to come in	None

Table 7. Cropping Calendar: Seeding and Fertilizer Recommendations

Field No.	Ac.	1950	1951	1952	1953	1954	Seeding Recommended	Fertilizer Recommended
1	7.8	Cotton	Corn (Oats (Fescue (Ladino	Oats (Fescue (Ladino	Fescue Ladino	Cotton	Cotton—1 bu. per ac. Fescue—10 lbs. per ac. Ladino—3 lbs. per ac.	Cotton—50 lbs. Nitrogen per ac.
2	7.5	Soybeans	Cotton	Corn (Oats (Fescue (Ladino	Oats (Fescue (Ladino	Fescue Ladino	Corn—14-in. apart Oats—4 bu. per ac.	Corn—120 lbs. Nitrogen Oats—40 lbs. Nitrogen under, 30 lbs. sidedressed
3	7	Oats (Fescue (Ladino	Fescue Ladino	Cotton	Corn (Oats (Fescue (Ladino	Oats (Fescue (Ladino		Fescue & Ladino—Will use fertilizer applied to oats
4	2	Oats Sweet Sudan	Oats Sweet Sudan	Oats Red Clover	Red Clover	Oats Sweet Sudan	Sudan—15 lbs. per ac.	Sudan—30 lbs. Nitrogen Red Clover—none
5	2	Oats Red Clover	Red Clover	Oats Sweet Sudan	Oats Sweet Sudan	Oats Red Clover		
6	8	Corn (Oats (Fescue (Ladino	Oats (Fescue (Ladino	Fescue Ladino	Cotton	Corn		
7	1	Truck Crops	Truck Crops	Truck Crops	Truck Crops	Truck Crops	**Contact Home Demonstration Agent for Seeding and Fertilizer Recommendations**	
8	.8	**To remain as Home-site**						
9	6.9	Bermuda Ladino Rye Grass	Bermuda Ladino Rye Grass	Bermuda Ladino Rye Grass	Bermuda Ladino Rye Grass	Bermuda Ladino Rye Grass	Bermuda-Sprig area Ladino—2 lbs. per ac. Rye Grass—15 lbs. per ac.	20 lbs. Nitrogen at planting date
10	8	Soybeans	Cotton	Cotton	Soybeans	Cotton	Soybeans—Plant Ogden beans 1½ bu. per ac.	Soybeans—no fertilizer
11	8	Cotton	Cotton	Soybeans	Cotton	Cotton		
12	8	Cotton	Soybeans	Cotton	Cotton	Soybeans		

How Coahoma County Soils Were Formed

This section of the bulletin is written for those farmers who are interested in knowing something of the origin of the soils on their farms. An understanding of the following information is not essential for good land use and farm management, however, knowledge concerning the formation of the soils on his farm may help the farmer get a better idea of his soil map.

Origin of Soil Materials—All of the soils of Coahoma County are composed of sands, silts and clays transported by the Mississippi River. Examining a map of the United States on which the Mississippi River and its tributary system is shown will indicate the complexity of the sediments from which the soils were formed. Sediments (sand, silts and clays) transported by any stream entering the Mississippi River north of Coahoma County may easily have been dropped within the county. In general, then the soils of this county are a combination of sands, silts and clays from some 20 states lying between the Rocky Mountains on the west and the Appalachian mountains on the east and north of the Coahoma County line. In other words, the soil locally called "mixed land" may be made up of sands from the hills of Kentucky, silts from the glacial section of Montana and the clays from the prairie sections of Iowa.

How the Soils Were Formed—The present and past activity of the Mississippi River is directly responsible for all of the soils in the county. The Mississippi River is a mature stream and such streams have very definite habits. A study of these habits is necessary for the understanding of soil formation in this county. A mature stream such as the Mississippi River maintains the same gradient or fall throughout the years and in order to do this, it must be cutting into the bank on one side and filling in on the other side. This cutting and filling causes the channel of the river to shift back and forth over its flood plain. Since the building of the first artificial levee system, this shifting back and forth or meandering has been more or less confined to the area in between the levees. Before the levees were constructed, the river shifted back and forth over the entire flood plain. Moon Lake is a good example of the river channel some hundred years ago. Annis Brake, Hanson Brake, Hull Brake and Little Sunflower River Brake are good examples of where the river channel was several hundred years ago.

In the flood plain of a mature stream there are annual overflows and it is at the time of these overflows that the sediments, from which the soils are formed, are deposited. The swiftness of the overflowing water determines whether or not sands, silts or clays are dropped. If the water is moving fast, the heavy sediments are dropped; namely, the sand and silts, and if the water is moving slowly or has stopped, the lightest sediments, namely, clays, are dropped. A combination of sediments are deposited by waters that move at a moderate speed. Essentially then the texture (the amount, sand, silt or clay) of the sediments are determined by the rate at which the flooding water flows. Since the particle size of the sands and silts is larger than that of the clays and the rapid floodwater deposits these sediments, any mature stream over a period of years of normal flooding tends to build up along its channels high banks of sand and silt called natural levees. These natural levees give rise to two groups of soil; namely, the First Bottom group and the Low Terrace group. The First Bottom group is made up of those soils on the recent natural levees that receive frequent overflows and have remained alkaline or "sweet." Along the present artificial levee, areas of soil are found that have remained alkaline or "sweet" because of seepage that occurs when the water level on the inside of the levee is high. These seep waters fall into the same first bottom group as the soils that receive normal overflow annually. The Low Terrace group of soils occur on the old natural levees found along the old river scars (ox-bow lakes or bayous) without active channels. These areas have remained above the overflow stage long enough for the soil to become leached or acid, and long enough for the forces of nature which start soil development to begin to work. On the soil map the first bottom group has its numbers begin with "1" and the low terrace group begins with "4."

Since most of the sand and silts are deposited along stream banks or on natural levees, the sediments that remain suspended in the flood water are clay. This clay is dropped after the water has slowed down or stopped, thus giving rise to another group of soils, the Low Bottom group. The soils of this group occur in the broad backwater of slackwater areas and are composed of heavy clay and clay sediments. These soils are commonly called "buckshot" ~~soils and on the soil map have their soil number begin with~~ "3."

The annual rainfall for the county is approximately 55 inches and at times of heavy rainfall several inches of water may fall in a 24-hour period. When the rain falls on the Mississippi River floodplain, it tends to collect in the low swags or depressional areas and remain there until it can find a way out through the natural or artificial drainage systems. These low swags or depressional areas give rise to another group of soils, the depressional group, denoted on the soil map with the first number as a "2." These areas received sediments from the surrounding slopes and ridges washed in by the rainwater and also receive backwater flooding when the river is at floodstage. This type of flooding deposits sediments with wide textural variations, thus giving rise to soils with widely varying characteristics.

Soil Series and Types of Coahoma County

MHOON SERIES

The Mhoon series include alluvial soils derived from the light textural alluvium of the Mississippi. They occur generally on the lowest elevations of recent natural levee formation and are the poorly drained soils of the "First Bottom" group. They occupy level to gently sloping topography, and are neutral to alkaline in reaction, and occupy relatively small areas.

Soil Types Within the Mhoon Series

124 Mhoon silty clay loam
125 Mhoon silt loam

SOIL PROFILE. (125 Mhoon silt loam.) The surface or plow layer is a pale to brown friable silt loam 4 to 6 inches deep. The subsoil, which starts at a depth of 4 to 6 inches and is 20 to 30 inches deep, is a light gray silt loam, mottled with varying shades of yellow and orange, slowly permeable to water. Below the subsoil is found a light gray silty clay loam to silty clay mottled with varying shades of yellow and orange. This profile is neutral to alkaline throughout. Other than a difference in surface texture (silty clay loam) the Mhoon silty clay loam soil profile is essentially the same as the Mhoon silt loam described.

USE AND MANAGEMENT. See Soil Group III, page 18.

COMMERCE SERIES

The soils of the Commerce series are imperfectly drained alluvial soils derived from light textured Mississippi River alluvium. They occur generally on the intermediate elevation of recent natural levee formations and fall in the "First Bottom" group of soils. They occupy level to gently sloping topography and are neutral to alkaline in reaction.

Soil Types Within the Commerce Series

133 Commerce silty clay
134 Commerce silty clay loam
135 Commerce silt loam
136 Commerce very fine sandy loam

SOIL PROFILE. (136 Commerce very fine sandy loam.) The surface is a pale brown, very friable, very fine sandy loam, 6 to 10 inches deep. The subsoil which starts at 6 to 10 inches, is 18 to 24 inches deep and is a yellowish brown friable silt loam faintly splotched with shades of yellow and orange, moderately permeable to water. Below the subsoil is a light brownish gray sandy loam mottled with shades of yellow and orange. This profile is neutral to alkaline throughout. Other than a difference in surface texture, the Commerce silty clay, the Commerce silty clay loam and Commerce silt loam profiles are essentially the same as Commerce very fine sandy loam.

USE AND MANAGEMENT. See Soil Group I, page 18.

ROBINSONVILLE SERIES

The soils of the Robinsonville series are the well drained alluvial soils derived from light textured Mississippi Rver alluvium. They occur on the higher elevations of recent natural levee formations and fall in the "First Bottom" group of soils. They occupy level to gently sloping topography and are neutral to alkaline in reaction.

Soil Types Within the Robinsonville Series

155 Robinsonville silt loam
156 Robinsonville very fine sandy loam

SOIL PROFILE. (156 Robinsonville very fine sandy loam.) The surface of this type is a yellowish brown friable very fine sandy loam, 8 to 10 inches deep. The subsoil, which starts at 8 to 10 inches, is 24 to 36 inches deep and is a yellowish brown loose loamy sand. This profile is neutral to alkaline throughout. Other than a difference in surface texture the Robinsonville silt loam is essentially the same as the Robinsonville very fine sandy loam.

USE AND MANAGEMENT. See Soil Group I, page 18.

DOWLING SERIES

The Dowling series includes the very poorly drained alluvial soils derived from sediments of the Mississippi River and occupies the "low swags" or depressional positions. The soils are frequently covered by water and are slightly acid in reaction.

Soil Types Within the Dowling Series

210 Dowling soils
212 Dowling clay
213 Dowling silty clay

SOIL PROFILE. (212 Dowling clay.) The surface of this soil is a dark gray clay, 2 to 3 inches deep. Just beneath the surface the subsoil begins and is a bluish gray plastic clay mottled with strong brown, 36 to 40 inches thick.

USE AND MANAGEMENT. See Soil Group VI, page 19.

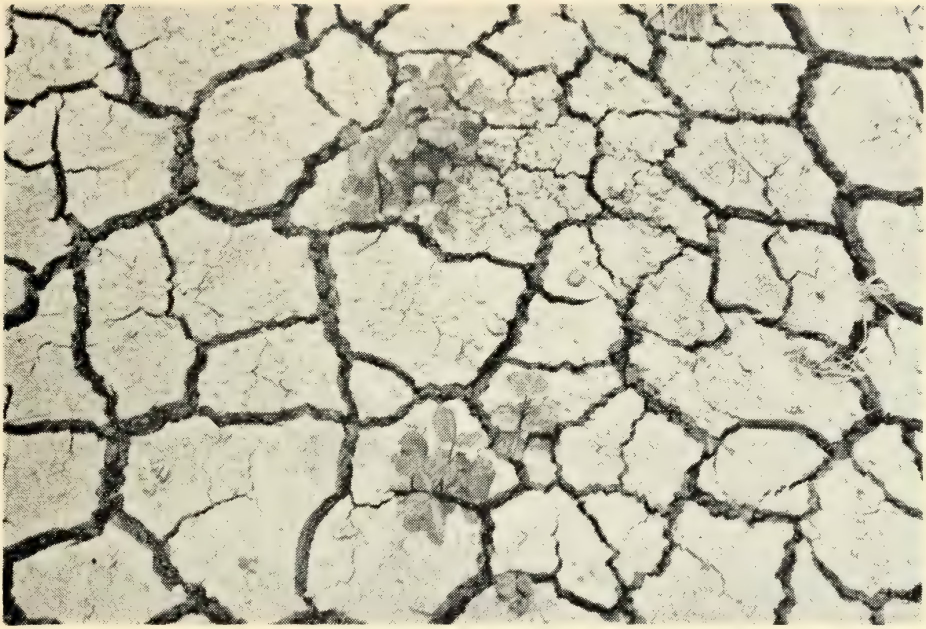
SOUVA SERIES

The Souva series includes the imperfectly drained alluvial soils derived from sediments of the Mississippi River and occupies the "low swags" or depressional areas. These soils are frequently covered by water and are slightly acid in reaction.

Soil Types Within the Souva Series

235 Souva silt loam

SOIL PROFILE. (235, Souva silt loam.) The surface of this soil is a dark



This picture shows how heavy clay soils crack open in dry weather. The soil type here is 312, Alligator clay.

brownish gray friable silt loam 6 to 10 inches deep. The subsoil just beneath is a brown friable silty clay loam to silty clay mottled with strong brown, 15 to 20 inches thick. Beneath this a pale brown to light gray silty clay loam mottled with strong brown. The soil is slight to medium acid.

USE AND MANAGEMENT. See Soil Group I, page 18.

ALLIGATOR SERIES

The soils of the Alligator series include the poorly drained alluvial soils derived from light-colored, heavy-textured, Mississippi River alluvium. They generally occur in the low slackwater areas of the floodplain and are referred to as "Low Bottom" soils, commonly called "buckshot." They occupy level to undulating topography and are slightly acid in reaction. This series generally occurs east of U. S. Highway 61 in the North Delta area. This series is closely associated to the Sharkey series.

Soil Types Within the Alligator Series
312 (422*) Alligator clay
313 Alligator silty clay

SOIL PROFILE. (312, Alligator clay.) The surface of this type is a very firm grayish brown clay, 2 to 4 inches deep, and is a gray to light gray silty clay to clay mottled with large yellowish red, slowly permeable to water. Other than surface texture Alligator silty clay is essentially the same as Alligator clay.

USE AND MANAGEMENT. See Soil Group V, page 19.

SHARKEY SERIES

The soils of the Sharkey series include the poorly drained alluvial soils derived from dark-colored, heavy textured Mississippi River alluvium They generally occur in the low slackwater areas of the

Cotton fertilizer test on 312, Alligator clay. This test was conducted in 1947 and shows response of cotton to nitrogen. Very little response to commercial fertilizer other than nitrogen was found on this soil during this particular year.

floodplain and are referred to as "Low Bottom" soils commonly called "buckshot." They differ from the Alligator series in that the subsoil is much darker in color and that the reaction is less acid. They occupy level to undulating topography and are slightly acid to neutral in reaction. The Sharkey and Alligator series with their associated depression comprise approximately 50 percent of the total land area of the North Delta.

Soil Types Within the Sharkey Series

322 Sharkey clay
323 Sharkey silty clay
324 Sharkey silty clay loam

SOIL PROFILE. (322 Sharkey clay.) The surface of this type is very firm dark grayish brown clay, 2 to 4 inches deep. The subsoil just beneath is 36 to 40 inches deep and is a dark gray to gray clay mottled with yellowish red, slowly permeable to water. Other than a difference in surface texture Sharkey silty clay and Sharkey silty clay loam are essentially the same as Sharkey clay.

USE AND MANAGEMENT. See Soil Group V, page 19.

TUNICA SERIES

The soils of the Tunica series include the somewhat poorly or imperfectly drained alluvial soils derived from Mississippi River alluvium. They resemble the Sharkey soil with which they are closely related but differ in that sandy material is found beneath the subsoil which accounts for the better drainage. The Tunica soils occur in small areas generally on the higher elevations within the slackwater or "Low Bottom" areas. They occupy gently sloping to undulating topography and are slightly acid to neutral in reaction.

Wheat growing on 322, Sharkey clay. The yield here was approximately 45 bushels per acre.

Sharkey clay commonly called "buckshot" grows fair corn when fertilized properly. This shows a hill of corn in a field of "buckshot." The yield here was 45-50 bushels per acre.

Red Clover growing on 323, Sharkey silty clay. This field was unfertilized and red clover is approximately 18 inches in height.

Soybeans in rows growing on 322, Sharkey clay. The field of soybeans averaged approximately 40 bushels per acre.

Cotton grows fairly well on 424, Forestdale silty clay loam. Under proper management one bale per acre can be expected over a five-year period. Large fields with long rows are well suited for mechanical harvesting.

Soil Types Within the Tunica Series

333 Tunica silty clay
334 Tunica silty clay loam

SOIL PROFILE. (333 Tunica silty clay.) The surface of this soil is a dark grayish brown, very firm silty clay, 3 to 4 inches deep. The subsoil just beneath is a very firm grayish brown clay, mottled slightly with yellowish red, slowly permeable to water. Beneath this subsoil is a layer of yellowish brown friable sandy loam to sandy clay loam mottled with yellowish red moderately permeable to water. Other than surface texture Tunica silty clay loam is essentially the same as Tunica silty clay.

USE AND MANAGEMENT. See Soil Group II, page 18.

FORESTDALE SERIES

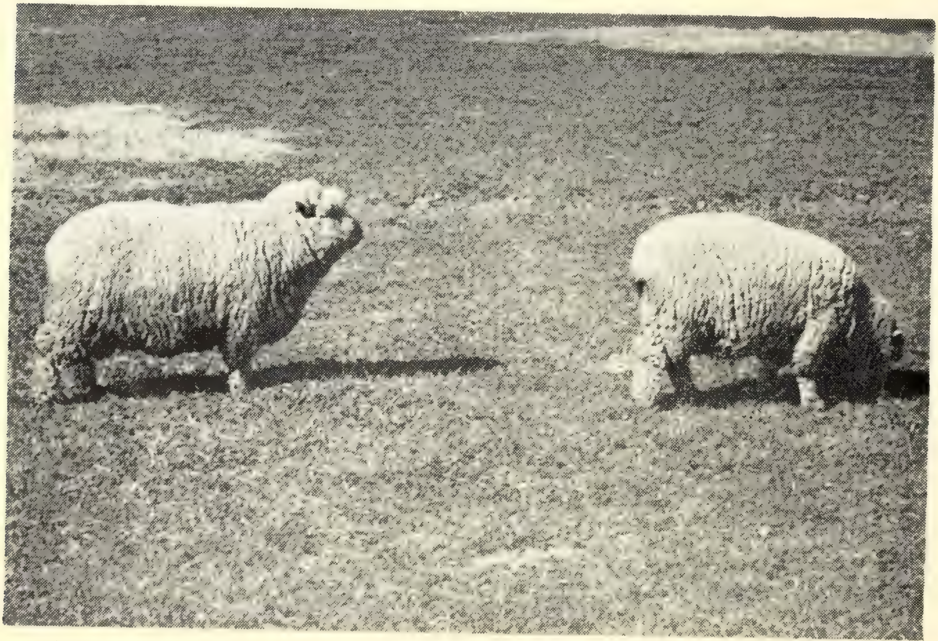
The soils of the Forestdale series are the poorly drained alluvial soils derived from medium to heavy texture sediments from the Mississippi River. These soils occur on the intermediate elevations of the old natural levee formations and fall in the "Low Terrace" group of soils. They have a significant amount of profile development and are medium to slightly acid in reaction.

Soil Types Within the Forestdale Series

423 Forestdale silty clay
424 Forestdale silty clay loam
425 Forestdale silt loam
426 Forestdale very fine sandy loam

SOIL PROFILE. (425 Forestdale silt loam.) The surface of this soil is a grayish brown, very friable silt loam, 4 to 6 inches deep. The subsoil just beneath is a friable to firm light gray silty clay loam to silty clay mottled with yellowish red, slowly permeable to water. Beneath this subsoil is a layer of light gray silty clay loam, somewhat lighter than the subsoil, mottled with yellowish red, slowly

A fine pasture of white clover and rye grass on 435, Dundee silt loam. Where the soil is acid (below 5.5 pH) lime should be applied to get best growth of clovers.



Sheep grazing a white clover and rye grass pasture on 435, Dundee silt loam.

Corn fertilizer test on 435, Dundee silt loam. This test was conducted in 1949 and picture shows response of corn to nitrogen. The four rows of corn in the center of the picture received no fertilizer whereas the surrounding corn received 120 pounds of nitrogen and varying rates of phosphorus and potassium. This particular test shows response to nitrogen only

permeable to water. Other than differences in surface texture, Forestdale very fine sandy loam, Forestdale silty clay and Forestdale silty clay loam are essentially the same as Forestdale silt loam.

USE AND MANAGEMENT. See Soil Group III, page 18.

DUNDEE SERIES

The soils of the Dundee series are the imperfect or somewhat poorly drained soils derived from the medium to light textured sediments of the Mississippi River. These soils occur on the intermediate elevations of the old natural levee formations and fall in the "Low Terrace" group of soils. They have a significant amount of profile development and are medium to slightly acid in reaction.

Soil Types Within the Dundee Series

434 Dundee silty clay loam
435 Dundee silt loam
436 Dundee very fine sandy loam

SOIL PROFILE. (436 Dundee very fine sandy loam.) The surface of this soil is a grayish brown very friable very fine sandy loam, 4 to 6 inches deep. The subsoil which starts at a depth of 6 to 8 inches is 12 to 16 inches thick and is a friable silty clay loam to silt loam, moderately slowly permeable to water, light grayish brown in color, and mottled with yellow. Beneath this subsoil is a layer of material somewhat sandier in texture, light gray in color and profusely mottled with yellowish red. Other than a difference in surface texture and a slightly heavier textured profile throughout, the Dundee silty clay loam and Dundee silt loam are essentially the same as Dundee very fine sandy loam.

USE AND MANAGEMENT. See Soil Group I, page 18.

DUBBS SERIES

The soils of the Dubbs series are the moderately well drained soils derived from light textured Mississippi River sediments. These soils occur on the higher elevations of the old natural levee formations and fall in the "Low Terrace" group of soils. They have a significant amount of profile development and are medium to slightly acid in reaction.

Soil Types Within the Dubbs Series

445 Dubbs silt loam
446 Dubbs very fine sandy loam

SOIL PROFILE. (446 Dubbs very fine sandy loam.) The surface of this soil is a grayish brown very friable very fine sandy loam 4 to 8 inches deep. The subsoil just beneath is a brown friable sandy clay loam to silty clay loam, some 12 to 14 inches thick, moderately permeable to water. Below the subsoil is a yellowish brown very friable very fine sandy loam 18 to 20 inches thick, rapidly permeable to water. This profile is relatively free of mottles. Other than a difference of surface texture Dubbs silt loam is essentially the same as Dubbs very fine sandy loam.

USE AND MANAGEMENT. See Soil Group I, page 18.

BOSKET SERIES

The soils of the Bosket series are the well drained alluvial soils derived from light textured Mississippi River alluvium. These soils occur on the higher elevations of old natural levee formations and fall in the "Low Terrace" group of soils. They occupy level to gently undulating topography and are slightly acid in reaction.

Soil Types Within the Bosket Series

456 Bosket very fine sandy loam
457 Bosket fine sandy loam

Corn grows best on good, well drained sandy loam soil. The field of corn is growing on 446, Dubbs very fine sandy loam and yielded approximately 135 bushels per acre.

SOIL PROFILE. (456 Bosket very fine sandy loam.) The surface of this type is a brown to light grayish brown very friable very fine sandy loam 6 to 8 inches deep. The subsoil which starts at 6 to 8 inches is 16 to 20 inches deep and is a yellowish brown very friable sandy clay loam. Below the soil is a layer of yellowish brown sandier material. The profile is slightly acid throughout. Other than a difference of surface texture, Bosket fine sandy loam is essentially the same as Bosket very fine sandy loam.

USE AND MANAGEMENT. See Soil Group I, page 18.

BEULAH SERIES

The Beulah series includes the somewhat excessively drained alluvial soils derived from light textured Mississippi River alluvium. In general they occur on the higher elevations of old natural levee formations and fall in the "Low Terrace" group of soils. They occupy level to gently undulating topography and are slightly acid in reaction.

Soil Types Within the Beulah Series
466 Beulah very fine sandy loam

SOIL PROFILE. (466 Beulah very fine sandy loam.) The surface of this type is a light brownish gray very friable very fine sandy loam, 8 to 10 inches deep. The subsoil which starts at 8 to 10 inches is 20 to 24 inches deep and is a yellowish brown very friable very fine sandy loam, rapidly permeable to water. Below this a layer of yellowish brown sand loam to loamy sand may be found. This profile is slightly acid throughout.

USE AND MANAGEMENT. See Soil Group I, page 18.

BULLETIN 476 DECEMBER 1950

Cotton Variety Tests
in the
Yazoo-Mississippi Delta
1946-49

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
FRANK J. WELCH, Director
STATE COLLEGE MISSISSIPPI

SUMMARY

The 1946 tests were described in bulletin 445 and the 1947 tests in bulletin 458 of the Mississippi Agricultural Experiment Station and in several issues of Mississippi Farm Research. The 1948 tests and the 1949 tests are described here and the tables presented herewith give detailed information on these tests and for the 2- and 3-year averages at each location.

In all tables the varieties are arranged according to the averages of the money-per-acre values for Middling, Strict Low Middling, and Low Middling grades.

Results at each location may be summarized as follows:

Stoneville: For 1948 the leading varieties were Delfos 9169, Empire, Deltapine 15, and Delfos 651. In 1949 Delfos 9169, Empire, Delfos 651, Deltapine 15, and Coker 100 Staple led. For the three-year period 1947-1948-1949 the high varieties were Delfos 9169, Empire, Deltapine 15 and Delfos 651.

Tunica: In the 1949 test leading varieties were Coker 100 Staple, Coker 100 Wilt, Empire, Delfos 651, and Delfos 9169. Averages for the two tests, 1947 and 1949, showed Stoneville 2B, Delfos 9169, Empire and Coker 100 Wilt to be the leading varieties.

Jonestown: For the 1948 test the highest money-value varieties were Delfos 651, Coker 100 Wilt, Miller, Empire, Deltapine 15 and Delfos 9169, closely grouped: the three-year average for 1946-1948 places Delfos 9169, Stoneville 2B, Coker 100 Wilt and Deltapine as leaders.

Valley Hill: The leading varieties in the 1948 test were Coker 100 Wilt, Delfos 9169, Bobshaw 1, Deltapine 15 and Empire, two of which are highly tolerant to Fusarium wilt. For the 1946-47-48 period Delfos 9169, Stoneville 2B, Miller and Coker 100 Wilt led.

Money. For the 1948 and 1949 tests the leading varieties were: 1948; Delfos 9169, Delfos 651, Stoneville 2B, Empire, Bobshaw and Deltapine: 1949; Delfos 9169, Empire, Bobshaw, Deltapine 15 and Coker 100 Staple. For the three-year (1947-1949) averages the leaders were Delfos 9169, Empire, Delfos 651, and Stoneville 2B.

Yazoo City: Leaders in the 1948 test were Empire, Delfos 9169, Deltapine 15, Delfos 651 and Coker 100 Wilt. In the 1949 test, Delfos 9169, Delfos 651, Deltapine 15 and Coker 100 Staple. Averages for 1947-1949 placed Delfos 9169, Deltapine 15 and Delfos 651 on top, with Stoneville 2B, Coker 100 Wilt, and Empire grouped closely in fourth place.

Kelso: For the 1948 test the leading commercial varieties were Delfos 9169, Miller, Coker 100 Wilt, Coker 100 Staple and Empire. Averages for the three-years, 1946 to 1948, place the money values of these six varieties very close together—Coker 100 Staple, Delfos 9169, Miller, Stoneville 2B, Coker 100 Wilt and Deltapine.

Cotton Variety Tests in the Yazoo-Mississippi Delta, 1946-49

By JAMES B. DICK and EARLY C. EWING, JR.[1]

One of the most important services rendered Delta cotton farmers by the Delta Branch Station over the last four decades has been the study and testing of the many and sundry cotton varieties offered for sale by seedsmen and commercial breeders. These studies have served to determine which varieties could be produced to best advantage in the Delta and which could be relied upon to give highest returns per acre under average conditions. Hundreds of varieties have been impartially tested in the many variety yield tests conducted in cooperation with county agents and interested planters in representative sections of the Yazoo-Mississippi alluvial area over this extensive period. The information obtained and published has been invaluable.

Changing economic conditions, consumer demand, and improved spinning machinery and methods have caused a gradual shift in production of Delta cotton from the fine, long-staple varieties to varieties with from 1-1/16 to 1-5/32 inch staple. Short cotton has never been produced to advantage in the alluvial section of Mississippi and present demand, price range, and labor conditions prohibit the extensive planting of the extra long staple varieties which produce less and require special handling.

Many new varieties and strains of cotton are studied each year at the Delta Station in strains tests, but the "standard variety tests" conducted throughout the Delta embrace only a limited number of current strains of commercial varieties which are commonly grown in the Delta and new varieties which have "graduated with honors" from the larger strains tests.

Although the variety trials must of necessity be conducted on a limited plot basis, every effort is made to have them represent actual plantation production practices. All plots are randomized, replicated several times, and the data is subjected to statistical analysis.

Characteristics which are determined and reported upon are: yield of seed cotton and of lint in pounds per acre, gin turnout, staple length, number of bolls per pound of seed cotton, earliness, fiber tensile strength, and fiber length uniformity. Total money value per acre is given, based upon Middling, Strict Low Middling and Low Middling grades.

Yields of seed cotton are based upon weights harvested from all plots at each location. Yields of lint are based upon yields of seed cotton and gin turnouts.

For the Stoneville test the gin turnout, staple length, and fiber properties were determined from ten 100-boll samples from each variety. For the other locations 2-pound samples were drawn from the harvested seed cotton of all rows of four series, providing four samples of each variety.

Staple length determinations were made by the Staple Cotton Cooperative Association, Greenwood, Mississippi, and by the Greenwood office of the Board of Cotton Examiners, Production and Marketing Administration, United States Department of Agriculture.

Boll sizes are given only for the Stoneville test and are based upon the average weight of ten 100-boll samples from each variety. Relative boll size of varieties will hold for the other locations, within reasonable limits.

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[1] Agronomist and Associate Breeder, respectively. This report is based upon results from cooperative research conducted by the Mississippi Agricultural Experiment Station and Division of Cotton and Other Fiber Crops, Bureau of Plant Industry, Soils and Agricultural Engineering, United States Department of Agriculture.

The percentage of cotton obtained at first picking, which is considered a measure of earliness, was determined by dividing the weight of the first picking by the weight of the total production.

The fiber tensile strength and the fiber length uniformity of these cottons were determined by the Knoxville Laboratory of the Division of Cotton and Other Fiber Crops, United States Department of Agriculture.

The money values per acre are based upon: (1) Yields of seed and lint, (2) staple lengths, and (3) seed grades. The values for the three grades, Middling, Strict Low Middling, and Low Middling, are given. The average prices for cotton of the respective grades and several staple lengths for the active Memphis spot cotton market for September and October were used. The seed were evaluated on a basis of average market price, with premiums and discounts in accordance with official standards for grading cottonseed set up by the United States Department of Agriculture. Analyses of samples of seed taken at the first picking were made in the Stoneville Laboratory of the Production and Marketing Administration

Differences representing significance between varietal averages for each of the characteristics are included in the bottom two lines of the tables. To be considered significant, the difference between any two varietal averages in a column must be greater than the item designated as "barely significant." Varieties mentioned as leading varieties generally fall within the range of barely significant difference below the variety with highest value per acre. In some tests several of the varieties are so closely grouped in value per acre that there is no clear cut line of differentiation, and the several varieties are cited.

The current report is divided into three parts: (1) The individual 1948 tests, (2) the 1949 tests, and (3) the average of tests for two or three years within the 1946-49 period at the same location.

1948 Variety Trials

The season of 1948 was a very favorable one for cotton production and resulted in a "bumper crop" in the middle and lower Delta. Field averages of 1-1/2 bales per acre were not unusual in these sections. In the North Delta much cotton was planted late because of rainy weather and failed to mature fully before the unusually early killing frosts of October 21 and 22, resulting in reduced yields. Weevil damage was low. Good harvesting conditions prevailed during September and October.

During the 1948 season the Delta Branch Experiment Station planted variety trials at Stoneville, Tunica, Jonestown, Money, Valley Hill, Yazoo City and Kelso Plantation. All tests were harvested and considered valid except the Tunica test which had to be replanted and was not harvested because the unfavorable weather of November caused excessive wastage that could not be computed.

Ten varieties were included in these tests, eight of which are commercially grown in the Delta. Wilds, which is also grown to a limited extent, was entered as the best long staple variety available, and Miller was included as the short staple variety best adapted to the area. The design used was a randomized complete block, with eight or ten replications, and single row plots.

A brief summary of conditions peculiar to each test is given below, and footnotes on the tables of results denote dates of planting and harvesting. Results of the 1948 tests at the six locations are given in tables 1, 6, 8, 11, 13, and 16 and in the summary.

The Stoneville test was located at the Delta Branch Experiment Station on sandy loam soil, typical of the banks along upper Deer Creek.

The test near Jonestown was located on the Eagle Nest Plantation and was conducted in cooperation with C. E Rhett, manager. The soil is a sandy loam. Only one picking was made on this test. Some loss in yield was experienced because of late planting and the early frost which damaged many bolls.

The Money test was located on Wildwood Plantation on the east bank of the Tallahatchie River and was conducted in cooperation with H. L. Gary, owner, and J. S. McBee, County Agent of Leflore county. The soil is a fine sandy loam and is well drained. The season was favorable, boll weevil damage light, and resulting yields were high.

The Valley Hill test was located near the eastern border of the Delta on light colored, well-drained silt loam soil made of outwash from the hills, and was conducted in cooperation with L. S. Hemphill on his plantation near Valley Hill. Early "damping off" damaged the original stand to some extent. Heavy weevil infestation in early August curtailed yield, and Fusarium wilt damage was scattered throughout the plots. One picking on September 27 harvested the test.

In cooperation with Emile "Bud" Schaeffer, owner, and the County Agent of Yazoo County, the variety trial for the southeastern part of the Delta was conducted on the Schaeffer plantation, three miles west of Yazoo City. The soil is a fine sandy loam and is well drained. Weather conditions were most favorable during the growing season; weevil damage came late and yields were very high.

The Kelso test was located near the Sharkey-Issaquena County line, 11 miles south of Cary on Highway 61. It was conducted in cooperation with James Hand, owner. The soil is a fine sandy loam, well-drained, and typical of Deer Creek soil in the above named counties. The test was planted in 40-inch check rows as in previous years, thinned to six plants per hill, and cultivated with 4-row equipment. Conditions were very favorable throughout the season, with only late, light weevil damage.

1949 Variety Trials

For many years the Delta cotton variety tests have been conducted on sandy loam soil types. Realizing that a large percentage of open farm land in the Delta is "buckshot" or clay soil an effort was made to locate a part of the 1949 variety trials on this type soil. Three such tests were planted; at Stoneville, Tunica, and Clarksdale. Four variety tests were conducted on sandy loam at Stoneville, Tunica, Money and Yazoo City. The tests at Jonestown, Valley Hill and Kelso were discontinued. The current strains of the ten varieties planted in the 1948 tests were used in 1949.

The season of 1949 was disastrous in many parts of the Delta because of excessive rainfall and unprecedented boll weevil infestation. Insect control measures with some of the newer organic insecticides were effective in many places. The dry month of September was followed by a wet October which delayed harvesting and caused heavy losses in grade of lint as well as viability of the seed. November and December were excellent for harvesting.

The Stoneville test was planted on the same area used in 1948. Pickings were made on August 22 and 29, September 6 and 12, and October 17. Earliness was computed from the total of the August 22 and 29 pickings. The insect-control program conducted by the Station entomologists controlled weevil infestation with the resultant high yields for that test.

The Tunica loam test was conducted in cooperation with Wesley R. Bailey, operator, and Jack Barnette, County Agent of Tunica County on the Mangum Estate, three miles west of Tunica. The soil is classed as Robinsonville silt loam.

The Money test was conducted on the same area as the 1948 test. Thorough control measures and a favorable July prevented excessive weevil damage and yields were higher than in 1948.

The test at Yazoo City was also conducted with the same cooperator and on the same area as in 1948. Insect control measures were practiced to excellent advantage as far as weather permitted.

Results of the 1949 variety trials on sandy loam are given in tables 2, 4, 9 and 14.

1949 "Buckshot" Variety Trials

A number of difficulties were experienced with the three variety tests planted on buckshot or clay soil. The Stoneville test on loamy clay on the Delta Station had to be planted over in May and through error did not receive the full insect control program, with resulting lowered yields. Plots of two varieties could not be used.

The Clarksdale test was located on the Hopson Plantation on loamy buckshot and also had to be replanted in mid-May.

The Tunica buckshot test was conducted on the Ark Bayou place, six miles southeast of Dundee in cooperation with Ransome A. Meyer, and County Agent Jack Barnette. This test was subjected to extremely wet weather during the entire season, and attempted insect control measures could not reach full effectiveness. Yields were quite low.

Because of these difficulties much of the detailed information like that obtained from the sandy loam tests is not available. In table 18 is given the yield of seed cotton and of lint per acre, gin turnout, and staple length for each test. The data given should be considered as indicative rather than conclusive.

2- and 3-Year Variety Studies

Seasonal conditions greatly affect the yield of cotton and modify to some extent other characteristics and properties of varieties. Average results of the several variety trials conducted at different locations in the Delta in one year provide interesting and useful information on some varietal characteristics, but are probably not indicative of long-time performance. It is believed that the average results of tests conducted over a period of several years in a given locality provide the grower residing in the vicinity of the test, or farming on a similar soil type, with more reliable information as to the behavior of a variety under average conditions than a single year's results.

Methods used in conducting the individual tests for 1948 and 1949 have been briefly described above. For the 3-year periods the yield of seed cotton was determined by averaging the seed cotton yields of each variety obtained during each season that the tests were conducted at a given locality. The yields of lint were obtained by multiplying the average gin turnout by the average yield of seed cotton per acre.

The gin turnout, the staple length, the number of bolls required for a pound of seed cotton, the percent of seed cotton picked during the first picking, the fiber tensile strength, and the fiber length uniformity ratio were determined by averaging the values obtained for each variety during the seasons that the tests were conducted at a given location.

The money values per acre for each grade were obtained by averaging the total money-per-acre values for the 2- or 3-year period for that particular grade for each variety.

The standard variety trials at Jonestown, Valley Hill and Kelso were discontinued after the 1948 season, but 3-year averages for these locations are available on nine varieties for the period 1946-1948 and are given in tables 7, 12 and 17. In 1947 Empire was placed in the variety trials for the first time and could be included in the 2- and 3-year averages. Table 5 gives the average of the Tunica tests for 1947 and 1949, and tables 3, 10 and 15 give the 3-year averages (1947-1948-1949) for the Stoneville, Money and Yazoo City locations.

Table 1. Yield and other data, cotton variety test, Stoneville, 1948

Variety	Yield per acre		Gin turn-out	Staple length	Bolls per lb. seed cotton	Percent picked first picking	Fiber tensile strength lbs. per sq. inch	Fiber length uniformity	Total money value per acre		
	Seed cotton	Lint							Middling	Strict low middling	Low middling
	Lbs.	Lbs.	Pct.	1/32 in.	Bolls	Pct.	1000 lbs.	Ratio	Dols.	Dols.	Dols.
Delfos 9169	2818	975	34.6	34.2	65.3	70.9	82.3	80.9	391	378	324
Empire P43 W.R.	2704	957	35.3	34.0	57.2	73.4	89.1	82.7	378	366	315
Deltapine 15	2474	970	39.2	34.0	75.3	52.6	83.5	84.6	370	358	305
Delfos 651	2622	871	33.2	34.5	70.8	66.9	87.3	81.4	360	346	293
Coker 100 Wilt	2516	860	34.2	34.2	68.7	57.0	83.9	83.2	340	329	282
Miller	2497	876	35.1	32.7	63.2	46.5	84.1	84.8	337	326	287
Stoneville 2B	2373	821	34.6	34.5	65.3	64.3	86.8	81.3	327	316	272
Bobshaw 1	2335	789	33.8	34.2	68.0	63.0	90.2	82.9	314	304	262
Coker 100 Staple	2212	748	33.8	35.0	75.3	55.1	89.0	81.5	308	296	259
Wilds	1975	598	30.3	39.5	74.7	42.4	96.9	82.8	343	293	210
Difference barely significant	239	82	4.1	0.6	2.0	5.2	2.8	1.7	33	31	29
Difference highly significant	318	109	5.5	0.9	2.7	6.9	3.9	2.3	43	41	38

Note: Planted on April 23, first picking was made on September 2.

Table 2. Yield and other data, cotton variety test, Stoneville, 1949

Variety	Yield per acre		Gin turn-out	Staple length	Bolls per lb. seed cotton	Percent picked first picking	Fiber tensile strength lbs. per sq. inch	Fiber length uniformity	Total money value per acre		
	Seed cotton	Lint							Middling	Strict low middling	Low middling
	Lbs.	Lbs.	Pct.	1/32 in.	Bolls	Pct.	1000 lbs.	Ratio	Dols.	Dols.	Dols.
Delfos 9169	2837	950	33.5	35.6	67.5	40.0	73.2	76.5	352	329	288
Empire P45 WR	2684	910	33.9	35.0	57.9	50.1	79.3	79.6	329	311	274
Delfos 651	2725	877	32.2	35.9	71.9	45.3	77.1	77.4	330	308	268
Deltapine 15	2446	929	38.0	35.1	76.4	46.4	75.5	81.0	327	308	270
Coker 100 Staple	2562	858	33.5	36.3	72.9	45.5	77.9	76.4	326	301	259
Bobshaw 1	2618	867	33.1	35.1	71.3	45.9	77.9	77.3	316	298	262
Coker 100 Wilt	2582	870	33.7	35.5	73.2	45.3	73.8	79.9	317	297	260
Miller	2499	880	35.2	33.5	67.8	44.1	73.1	82.3	310	293	259
Stoneville 2B	2565	859	33.5	35.0	65.5	38.5	78.0	78.4	310	293	258
Wilds	2089	639	30.6	40.4	69.5	28.8	86.2	75.4	356	277	202
Diff. Barely Sign.	153	52	0.5	0.4	1.8	5.6	3.6	3.1			
Diff. Highly Sign.	203	69	0.6	0.5	2.4	7.4	4.9	4.1			

Note: Planted on April 21, earliness based on cotton picked through August 29.

Table 3. Yield and other data, cotton variety test, Stoneville, average 3-years 1947-48-49

Variety	Yield per acre		Gin turn-out	Staple length	Bolls per lb. seed cotton	Percent picked first picking	Fiber tensile strength lbs. per sq. inch	Fiber length uniformity	Total money value per acre		
	Seed cotton	Lint							Middling	Strict low middling	Low middling
	Lbs.	Lbs.	Pct.	1/32 in.	Bolls	Pct.	1000 lbs.	Ratio	Dols.	Dols.	Dols.
Delfos 9169	2721	924	33.9	35.2	65.4	56.4	78.9	78.9	373	357	308
Empire P45 WR	2619	908	34.6	34.7	57.3	64.5	83.6	81.2	359	345	300
Deltapine 15	2411	925	38.4	34.7	74.1	53.1	79.3	82.9	352	338	291
Delfos 651	2560	842	32.9	35.4	71.8	58.7	81.7	79.3	346	330	283
Stoneville 2B	2503	852	34.1	34.9	64.3	54.9	82.7	80.2	339	326	283
Coker 100 Wilt	2478	838	33.8	35.1	69.8	53.7	79.7	81.1	333	319	275
Bobshaw 1	2452	821	33.5	34.8	69.0	57.0	84.1	80.5	326	314	273
Miller	2394	840	35.1	33.3	64.1	48.4	79.2	83.9	321	309	273
Coker 100 Staple	2313	778	33.7	35.8	72.7	51.9	83.6	79.9	319	303	260
Wilds	1963	592	30.1	40.3	72.6	39.0	92.0	79.5	326	277	207

Table 4. Yield and other data, cotton variety test, Tunica, 1949

Variety	Yield per acre		Gin turn-out	Staple length	Percent picked first picking	Fiber tensile strength lbs. per sq. inch	Fiber length uniformity	Total money value per acre		
	Seed cotton	Lint						Middling	Strict low middling	Low middling
	Lbs.	Lbs.	Pct.	1/32 in.	Pct.	1000 lbs.	Ratio	Dols.	Dols.	Dols.
Coker 100 Staple	2684	870	32.4	38.2	55.1	82.9	78.2	404	352	266
Coker 100 Wilt	2515	817	32.5	37.7	47.3	78.6	80.6	357	319	252
Empire P45 WR	2849	903	31.7	35.7	59.3	81.7	79.9	329	314	274
Delfos 651	2686	841	31.3	36.7	59.7	80.4	76.6	333	304	259
Delfos 9169	2649	842	31.8	36.7	55.2	77.6	78.5	333	304	258
Bobshaw 1	2718	834	30.7	35.9	55.1	79.1	82.1	309	296	258
Deltapine 15	2327	854	36.7	36.1	59.3	76.9	79.8	316	292	253
Miller	2560	863	33.7	33.9	59.2	75.2	82.5	308	283	258
Stoneville 2B	2533	808	31.9	36.0	57.0	79.2	78.4	306	285	248
Wilds	1963	573	29.2	42.2	47.2	90.4	77.4	338	265	187
Diff. Barely Sign.	240	78	0.7	0.9	4.5	4.3	2.7			
Diff. Highly Sign.	319	104	1.0	1.2	5.9	5.8	3.6			

Note: Planted April 22, picked on September 9 and October 22.

Table 5. Yield and other data, cotton variety test, Tunica, average 2-years—1947 and 1949

Variety	Yield per acre		Gin turn-out	Staple length	Percent picked first picking	Fiber tensile strength lbs. per sq. inch	Fiber length uniformity	Total money value per acre		
	Seed cotton	Lint						Middling	Strict low middling	Low middling
	Lbs.	Lbs.	Pct.	1/32 in.	Pct.	1000 lbs.	Ratio	Dols.	Dols.	Dols.
Stoneville 2B	2281	779	34.4	35.0	57.4	81.4	80.1	309	295	257
Delfos 9169	2254	767	34.5	35.6	54.0	79.2	78.8	312	294	253
Empire P45 WR	2306	798	35.5	34.6	59.8	83.4	79.9	305	294	257
Coker 100 Wilt	2136	735	34.8	36.1	51.6	80.6	80.0	314	292	241
Bobshaw 1	2326	765	33.3	35.2	56.0	83.4	81.8	298	287	251
Coker 100 Staple	2073	713	35.2	36.5	57.2	83.6	79.8	318	288	230
Delfos 651	2213	739	33.9	35.5	59.5	82.3	77.6	301	283	244
Deltapine 15	1978	778	39.9	34.7	59.9	79.0	81.2	294	278	243
Miller	2108	751	36.1	32.7	62.3	79.0	83.3	281	265	239
Wilds	1709	539	32.0	40.2	51.2	93.4	78.3	290	245	186

Table 6. Yield and other data, cotton variety test, Jonestown, 1948

Variety	Yield per acre		Gin turn-out	Staple length	Fiber tensile strength lbs. per sq. inch	Fiber length uniformity	Total money value per acre		
	Seed cotton	Lint					Middling	Strict low middling	Low middling
	Lbs.	Lbs.	Pct.	1/32 in.	1000 lbs.	Ratio	Dols.	Dols.	Dols.
Delfos 651	2036	654	32.1	35.3	73.4	79.5	271	262	224
Coker 100 Wilt	2000	680	34.0	34.6	72.4	81.2	269	261	225
Miller	1883	666	35.4	33.3	69.8	82.1	258	250	218
Empire P43	1818	609	33.5	34.8	75.3	79.0	246	238	205
Deltapine 15	1660	632	38.1	34.5	73.1	80.5	242	235	201
Delfos 9169	1782	595	33.4	34.8	72.0	77.9	241	233	201
Bobshaw 1	1681	561	33.4	34.6	72.3	79.3	223	216	186
Coker 100 Staple	1624	528	32.5	35.9	74.9	78.4	221	213	178
Wilds	1334	403	30.2	40.0	83.7	80.6	230	199	143
Stoneville 2B	1514	509	33.6	34.6	74.6	78.5	203	197	170
Difference barely significant	225	77	1.2	0.8	2.6	2.5	32	30	25
Difference highly significant	299	102	1.6	1.1	3.6	3.4	42	40	34

Note: Planted May 17, harvested December 1.

Table 7. Yield and other data, cotton variety test, Jonestown, average 3-years—1946-47-48

Variety	Yield per acre		Gin turn-out	Staple length	Fiber tensile strength lbs. per sq. inch	Fiber length uniformity	Total money value per acre		
	Seed cotton	Lint					Middling	Strict low middling	Low middling
	Lbs.	Lbs.	Pct.	1/32 in.	1000 lbs.	Ratio	Dols.	Dols.	Dols.
Delfos 9169	1993	668	33.5	34.7	76.4	77.5	283	275	243
Stoneville 2B	1986	671	33.7	34.4	78.5	77.8	282	274	243
Coker 100 Wilt	1986	668	33.7	34.5	76.9	80.9	278	270	238
Deltapine 15	1803	697	38.8	34.0	76.5	80.5	278	270	238
Miller	1930	679	35.2	32.9	75.3	82.5	276	268	238
Bobshaw 1	1976	655	33.2	34.2	78.6	79.8	275	267	236
Delfos 651	1909	618	32.5	35.0	77.6	77.6	266	258	227
Coker 100 Staple	1807	603	33.5	35.4	78.6	78.7	257	249	217
Wilds	1442	441	30.7	39.2	88.2	77.7	229	209	167

Table 8. Yield and other data, cotton variety test, Money, 1948

Variety	Yield per acre		Gin turn-out	Staple length	Fiber tensile strength lbs. per sq. inch	Fiber length uniformity	Total money value per acre		
	Seed cotton	Lint					Middling	Strict low middling	Low middling
	Lbs.	Lbs.	Pct.	1/32 in.	1000 lbs.	Ratio	Dols.	Dols.	Dols.
Delfos 9169	2504	849	33.9	34.8	73.0	80.6	343	332	287
Delfos 651	2351	769	32.7	35.3	76.9	80.5	318	307	261
Stoneville 2B	2277	774	34.0	34.4	78.7	80.9	308	299	258
Empire P43 W.R.	2196	749	34.1	34.4	80.3	82.6	300	291	251
Bobshaw 1	2198	739	33.6	34.4	81.1	82.7	295	286	247
Deltapine 15	2018	775	38.4	34.0	74.0	83.4	295	286	246
Coker 100 Wilt	2054	703	34.2	35.1	74.4	83.0	280	272	232
Coker 100 Staple	1980	663	33.5	35.4	79.1	80.7	270	261	221
Miller	1917	667	34.8	32.4	74.2	84.1	257	249	219
Wilds (1848)	1685	502	29.8	39.9	88.1	83.1	287	249	180
Difference barely significant	173	58	.8	1.2	2.2	1.7	25	23	17
Difference highly significant	230	77	1.0	1.6	3.0	2.3	32	31	23

Note: Planted April 21, first picking was on September 21, too late for "earliness" data.

Table 9. Yield and other data, cotton variety test, Money, 1949

Variety	Yield per acre		Gin turn-out	Staple length	Percent picked first picking	Fiber tensile strength lbs. per sq. inch	Fiber length uniformity	Total money value per acre		
	Seed cotton	Lint						Middling	Strict low middling	Low middling
	Lbs.	Lbs.	Pct.	1/32 in.	Pct.	1000 lbs.	Ratio	Dols.	Dols.	Dols.
Delfos 9169	2850	943	33.1	36.4	45.5	85.4	79.7	364	335	288
Empire P45 WR	2781	957	34.4	35.2	54.9	90.6	81.3	346	327	288
Delfos 651	2552	817	32.0	36.6	45.0	89.4	80.0	322	294	251
Bobshaw 1	2587	851	32.9	35.6	45.8	91.3	80.4	309	294	257
Deltapine 15	2275	864	38.0	35.1	44.3	86.6	83.9	303	286	251
Coker 100 Staple	2364	797	33.7	36.7	39.4	92.3	78.7	312	284	241
Miller	2370	848	35.8	33.4	32.0	89.8	82.8	297	281	248
Coker 100 Wilt	2352	797	33.9	35.7	37.7	88.3	82.1	287	273	238
Stoneville 2B	2309	771	33.4	35.6	40.5	90.9	78.8	280	266	232
Wilds	1869	553	29.6	41.6	29.1	97.9	78.4	326	253	180
Difference barely significant	234	79	1.0	0.7	5.1	3.2	2.7			
Difference highly significant	310	104	1.4	0.9	6.7	4.4	3.6			

Note: Planted April 26, first picking was made on September 15.

Table 10. Yield and other data, cotton variety test, Money, average 3-years—1947-48-49

Variety	Yield per acre		Gin turn-out	Staple length	Percent picked first picking	Fiber tensile strength lbs. per sq. inch	Fiber length uniformity	Total money value per acre		
	Seed cotton	Lint						Middling	Strict low middling	Low middling
	Lbs.	Lbs.	Pct.	1/32 in.	Pct.	1000 lbs.	Ratio	Dols.	Dols.	Dols.
Delfos 9169	2615	909	34.8	35.0	65.0	79.0	79.2	365	349	303
Empire P45 WR	2422	861	35.6	34.4	72.0	85.1	80.4	335	323	283
Delfos 651	2433	819	33.7	35.4	64.5	82.0	79.1	336	320	275
Stoneville 2B	2337	817	34.9	34.7	61.8	83.7	79.8	321	310	270
Bobshaw 1	2331	802	34.5	34.6	66.5	85.8	81.0	314	303	265
Deltapine 15	2075	822	39.7	34.2	62.0	80.5	82.7	307	295	257
Coker 100 Wilt	2196	767	34.9	34.9	60.2	81.4	81.0	298	288	250
Coker 100 Staple	2075	722	34.9	35.5	61.8	84.6	79.2	292	277	237
Miller	2094	759	36.3	32.6	56.4	81.5	82.4	286	275	243
Wilds	1748	541	31.0	40.3	51.9	93.5	79.7	298	254	190

Table 11. Yield and other data, cotton variety test, Valley Hill, 1948

Variety	Yield per acre		Gin turn-out	Staple length	Fiber tensile strength lbs. per sq. inch	Fiber length uniformity	Total money value per acre		
	Seed cotton	Lint					Middling	Strict low middling	Low middling
	Lbs.	Lbs.	Pct.	1/32 in.	1000 lbs.	Ratio	Dols.	Dols.	Dols.
Coker 100 Wilt	1472	509	34.5	34.5	75.7	80.6	193	186	160
Delfos 9169	1431	494	34.5	34.8	77.1	78.5	192	185	158
Bobshaw 1	1247	424	34.0	34.3	80.5	79.6	164	155	137
Deltapine 15	1110	432	38.9	34.3	79.2	81.0	158	153	130
Empire P43 W.R.	1141	407	35.7	34.0	82.5	81.0	157	152	132
Miller	1110	398	35.9	32.6	80.7	84.8	149	144	126
Stoneville 2B	1049	357	34.0	34.6	78.1	78.2	136	132	113
Delfos 651	1024	340	33.2	34.5	79.4	79.4	132	128	110
Coker 100 Staple	959	322	33.6	35.3	78.5	78.2	125	121	102
Wilds (1948)	644	193	29.9	39.4	87.9	81.7	110	94	67
Difference barely significant	122	42	0.6	0.7	1.9	3.2	18	17	15
Difference highly significant	162	56	0.8	0.9	2.6	4.4	24	23	20

Note: Planted April 24, picked September 27.

Table 12. Yield and other data, cotton variety test, Valley Hill, average 3-years—1946-47-48

Variety	Yield per acre		Gin turn-out	Staple length	Fiber tensile strength lbs. per sq. inch	Fiber length uniformity	Total money value per acre		
	Seed cotton	Lint					Middling	Strict low middling	Low middling
	Lbs.	Lbs.	Pct.	1/32 in.	1000 lbs.	Ratio	Dols.	Dols.	Dols.
Delfos 9169	1505	514	34.2	35.1	78.5	80.3	217	210	184
Stoneville 2B	1459	501	34.3	34.7	80.4	81.3	210	204	179
Miller	1422	508	35.8	32.9	80.9	84.4	206	200	178
Coker 100 Wilt	1453	491	33.8	35.0	79.7	81.8	204	198	173
Bobshaw 1	1431	486	34.0	34.2	84.5	82.7	203	196	174
Deltapine 15	1289	498	38.7	34.6	80.8	82.0	198	192	168
Coker 100 Staple	1243	423	34.0	35.6	80.4	80.8	179	174	151
Delfos 651	1228	405	33.5	34.9	80.2	80.3	172	167	147
Wilds	936	287	30.5	39.8	90.2	82.3	149	137	110

Table 13. Yield and other data, cotton variety test, Yazoo City, 1948

Variety	Yield per acre		Gin turn-out	Staple length	Percent picked first picking	Fiber tensile strength lbs. per sq. inch	Fiber length uniformity	Total money value per acre		
	Seed cotton	Lint						Middling	Strict low middling	Low middling
	Lbs.	Lbs.	Pct.	1/32 in.	Pct.	1000 lbs.	Ratio	Dols.	Dols.	Dols.
Empire	2522	918	36.4	34.1	61.8	88.9	84.4	359	348	300
Delfos 9169	2477	897	36.2	34.4	53.4	80.2	80.2	353	342	294
Deltapine 15	2203	927	42.1	33.4	48.5	82.3	85.3	343	332	286
Delfos 651	2455	852	34.7	34.4	59.6	87.5	81.8	338	327	282
Coker 100 Wilt	2401	869	36.2	34.0	60.7	82.9	83.8	334	324	279
Miller	2318	846	36.5	31.6	60.9	84.9	86.0	321	310	273
Stoneville 2B	2298	823	35.8	34.2	56.9	87.4	82.6	322	312	269
Wilds	2041	651	31.9	39.1	47.8	94.6	83.6	354	311	225
Bobshaw 1	2219	772	34.8	33.9	58.1	90.3	84.0	302	293	254
Coker 100 Staple	2090	738	35.3	34.5	59.2	88.1	81.6	291	282	243
Difference barely significant	215	77	2.1	.7	5.4	2.8	1.8	31	30	25
Difference highly significant	285	103	2.8	1.0	7.2	3.9	2.5	41	40	34

Note: Planted April 19, first picking made on August 26.

Table 14. Yield and other data, cotton variety test, Yazoo City, 1949

Variety	Yield per acre		Gin turn-out	Staple length	Percent picked first picking	Fiber tensile strength lbs. per sq. inch	Fiber length uniformity	Total money value per acre		
	Seed cotton	Lint						Middling	Strict low middling	Low middling
	Lbs.	Lbs.	Pct.	1/32 in.	Pct.	1000 lbs.	Ratio	Dols.	Dols.	Dols.
Delfos 9169	2605	826	31.7	35.9	43.0	76.5	77.0	306	293	256
Delfos 651	2527	809	32.0	36.2	48.6	79.8	76.7	311	288	249
Deltapine 15	2187	803	36.7	35.2	44.3	79.1	80.9	285	270	236
Coker 100 Staple	2252	739	32.8	**36.9**	43.6	78.7	78.9	296	268	226
Coker 100 Wilt	2304	756	32.8	35.7	43.1	79.1	78.5	275	262	229
Bobshaw 1	2322	741	31.9	35.0	44.3	81.5	79.1	271	256	226
Empire P45 WR	2272	727	32.0	35.5	54.2	83.2	77.9	268	255	224
Stoneville 2B	2182	716	32.8	35.5	36.1	82.8	77.3	261	248	218
Miller	2052	702	34.2	33.5	47.4	76.2	78.8	249	236	209
Wilds	1768	513	29.0	**40.6**	33.9	86.6	75.3	291	232	166
Difference barely significant	252	82	0.8	0.9	5.4	2.4	2.8			
Difference highly significant	335	109	1.1	0.6	7.1	3.3	NS			

Note: Planted April 19, picked September 7 and October 18.

Table 15. Yield and other data, cotton variety test, Yazoo City, average 3-years—1947-48-49

Variety	Yield per acre		Gin turn-out	Staple length	Percent picked first picking	Fiber tensile strength lbs. per sq. inch	Fiber length uniformity	Total money value per acre		
	Seed cotton	Lint						Middling	Strict low middling	Low middling
	Lbs.	Lbs.	Pct.	1/32 in.	Pct.	1000 lbs.	Ratio	Dols.	Dols.	Dols.
Delfos 9169	2554	890	34.9	34.9	53.7	78.8	78.6	352	340	296
Deltapine 15	2246	906	40.3	34.1	51.3	79.9	82.8	338	326	283
Delfos 651	2441	834	34.2	35.0	58.0	82.9	79.0	335	320	278
Stoneville 2B	2369	834	35.1	34.6	53.2	83.7	79.9	327	316	276
Coker 100 Wilt	2387	846	35.4	34.6	56.1	80.9	80.4	327	316	275
Empire P45 WR	2350	836	35.6	34.4	63.5	85.3	80.7	326	315	275
Bobshaw 1	2367	815	34.4	34.3	57.8	85.6	81.0	320	308	270
Miller	2211	800	36.1	32.5	59.5	79.8	82.6	304	292	258
Coker 100 Staple	2127	745	35.1	35.4	56.6	83.2	79.8	301	285	244
Wilds	1842	580	31.5	39.7	46.1	91.2	78.9	309	268	201

Table 16. Yield and other data, cotton variety test, Kelso, 1948

Variety	Yield per acre		Gin turn-out	Staple length	Percent picked first picking	Fiber tensile strength lbs. per sq. inch	Fiber length uniformity	Total money value per acre		
	Seed cotton	Lint						Middling	Strict low middling	Low middling
	Lbs.	Lbs.	Pct.	1/32 in.	Pct.	1000 lbs.	Ratio	Dols.	Dols.	Dols.
Delfos 9169	2372	849	35.8	34.8	83.3	80.0	81.2	337	326	280
Miller	2367	857	36.2	33.1	78.5	78.3	84.5	329	319	277
Coker 100 Wilt	2324	823	35.4	34.9	81.2	81.4	81.3	323	313	268
Coker 100 Staple	2244	779	34.7	36.0	75.5	85.8	81.2	323	309	257
Empire P43	2204	796	36.1	34.4	89.0	85.1	81.3	313	303	261
Delfos 651	2256	769	34.1	35.0	83.3	83.5	81.8	310	300	257
Wilds	1919	608	31.7	40.8	69.9	95.5	82.0	353	301	213
Stoneville 2B	2173	771	35.5	34.9	81.2	85.9	80.1	306	296	253
Bobshaw 1	2145	734	34.2	34.8	80.8	87.1	83.3	293	283	243
Deltapine 15	1923	773	40.2	34.2	77.7	80.3	82.7	291	282	241
Difference barely significant	135	48	.9	.8	3.9	2.8	1.5	20	19	16
Difference highly significant	179	63	1.2	1.1	5.2	3.8	2.0	26	25	21

Note: Planted on April 20, first picking was on September 17.

Table 17. Yield and other data, cotton variety test, Kelso, average 3-years—1946-47-48

Variety	Yield per acre		Gin turn-out	Staple length	Fiber tensile strength lbs. per sq. inch	Fiber length uniformity	Total money value per acre		
	Seed cotton	Lint					Middling	Strict low middling	Low middling
	Lbs.	Lbs.	Pct.	1/32 in.	1000 lbs.	Ratio	Dols.	Dols.	Dols.
Coker 100 Staple	1711	593	34.6	35.5	79.2	80.6	251	242	208
Delfos 9169	1712	597	34.6	34.8	76.7	79.8	248	241	211
Miller	1693	612	36.1	32.8	75.1	83.5	245	238	210
Stoneville 2B	1698	591	34.8	34.7	80.3	80.1	246	237	209
Coker 100 Wilt	1707	597	34.8	34.6	77.3	81.7	245	238	207
Deltapine 15	1569	620	39.4	34.2	76.4	81.5	245	238	208
Delfos 651	1678	567	33.7	34.9	78.6	80.0	239	232	203
Bobshaw 1	1631	557	34.1	34.3	81.5	82.8	231	224	197
Wilds	1442	449	31.1	39.6	90.5	81.3	241	216	168

Table 18. Yield of seed cotton and of lint, gin turnout, and classers staple length for ten varieties grown in cotton variety tests on "buckshot" soils at three locations in the Delta, 1949

Variety	STONEVILLE				CLARKSDALE				TUNICA			
	Yield per acre		Percent lint	Classers staple length	Yield per acre		Percent lint	Classers staple length	Yield per acre		Percent lint	Classers staple length
	Seed cotton	Lint			Seed cotton	Lint			Seed cotton	Lint		
	Lbs.	Lbs.	Pct.	1/32 in.	Lbs.	Lbs.	Pct.	1/32 in.	Lbs.	Lbs.	Pct.	1/32 in.
Bobshaw	--------	------	31.2	34	1121	391	34.9	34	950	310	32.7	35
Coker 100 Staple	1266	414	32.7	36	1275	450	35.3	35	967	321	33.2	37
Coker 100 Wilt	1521	506	33.3	35	1205	416	34.5	35	946	332	35.1	35
Delfos 651	1313	406	30.9	35	1444	504	34.9	35	960	316	32.9	35
Delfos 9169	1213	386	31.8	35	1406	489	34.8	34	960	327	34.1	36
Deltapine 15	1380	492	35.6	35	1131	440	38.9	34	1063	407	38.3	35
Empire	1422	454	31.9	34	1506	527	35.0	34	1010	363	36.0	35
Miller	1646	574	34.9	33	1482	550	37.1	33	1055	380	36.1	33
Stoneville 2B	1353	441	32.6	35	1330	466	35.1	35	936	317	33.9	35
Wilds	--------	------	27.8	40	1096	357	32.6	38	780	230	29.5	40

Note: Planted on May 12 Planted on May 13 Planted on April 22

BULLETIN 477 JANUARY 1951

1950 Cotton Variety Tests

In Hill Sections of Mississippi

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
FRANK J. WELCH, Director
STATE COLLEGE MISSISSIPPI

1950 COTTON VARIETY TESTS

HILL SECTIONS

By J. F. O'Kelly, S. P. Crockett, Louie Walton, and B. C. Hurt, Jr.

In 1950, the cotton producer in Mississippi had a harder fight than usual. Rainfall was at record or near record levels in most of the state from July to mid-September. An initially heavy weevil infestation increased as the season advanced. In some areas there was more boll worm (the corn earworm) than in many years. Damage from insects combined with the weather caused very heavy damage from the boll rots.

Under such handicaps the production of a fair to good yield was possible only through the judicious use of fertilizers and the persistent use of the better insecticides in addition to other good cotton production practices. Under such unusual environment a poor showing was made by some varieties which usually perform quite satisfactorily.

The test at Holly Springs was fertilized before planting with 1000 pounds of 6-8-4 to the acre and was planted May 9. The test was treated twelve times for weevil control. Several varieties which have performed quite well in the past did not yield so well this year.

The fertilizer treatment at State College was 600 pounds 6-8-4 to the acre applied at planting time April 25. During the fruiting season the test area was sprayed five times with toxaphene for weevil control and DDT was added to one spraying for boll worm control. The boll rots were so severe that an estimated 10 to 25 percent of the bolls were unfit to be harvested. It could not be determined if boll rot damage was responsible for the poor performance of some ordinarily high producing varieties.

The Brooksville test was fertilized before planting with 400 pounds 5-10-5 to the acre and was planted late in April. It was sprayed six times with benzene hexachloride for weevil control.

The tests at Newton have been planted in the same location each year on a soil which has relatively poor internal drainage. Plantings have been made each year on or about the middle of April and fair to good stands have been obtained each year. The fertility practice consists of 600 pounds 6-8-8 applied prior to planting and side dressing with about 30 pounds of nitrogen from ammonium nitrate.

The relatively new varieties in these tests include Fox, Plains, Arkot 2-1, and Pandora. Fox was developed by the Delta and Pine Land Company and has been tried enough to show that it is an excellent cotton for non-wilt soils which need an early and rapid fruiting variety. Plains has considerable wilt resistance and appears to be an excellent general purpose cotton. It was developed by workers at the Alabama Experiment Station. Arkot 2-1 was developed by workers at the Arkansas Experiment Station and appears to be in about the same class as some of the Stoneville strains, but possibly, a little earlier maturing. Pandora is a large leafed wilt resistant variety developed for South Georgia conditions. It is too early to determine if it may find a place in Mississippi.

STATE COLLEGE

Average results from cotton varieties, State College

	Pounds lint per acre					Averages 1946-1950				
	1946	1947	1948	1949	1950	Lint	Acre value	Staple inches	Lint per-cent.	Bolls per lb. lint
Deltapine 15	433.9	398.2	743.4	345.0	555.6	495.2	200.48	1 1/16	39.9	186
Miller	418.4	480.1	729.6	308.1	465.3	480.3	190.59	1	38.0	170
Coker, Staple	394.2	458.1	708.7	346.7	435.9	468.7	194.89	1 3/32	37.0	194
Bobshaw 1	435.4	422.7	722.6	380.9	344.2	461.2	186.06	1 1/16	36.1	197
Delfos 651	411.9	385.5	699.8	338.9	431.2	453.5	189.32	1 3/32	35.3	208
Coker, Wilt	423.0	357.1	707.2	343.0	411.2	448.3	182.76	1 3/32	37.0	187
Delfos 9169	453.4	370.4	693.9	361.3	360.1	447.8	182.30	1 3/32	36.4	186
Hi-Bred	379.3	438.8	685.3	340.5	336.3	436.0	161.30	29/32	42.1	149
Stoneville 2B	411.6	390.0	726.7	299.7	346.9	435.0	176.80	1 1/16	36.7	182
Empire	411.6	364.0	677.9	386.9	307.2	429.5	171.75	1 1/16	37.4	161

Cotton varieties, State College, 1950

	Pounds lint per acre	Acre value seed and lint			Lint per-centage	Staple inches	Bolls per lb. lint
		Middling	Strict low middling	Low middling			
Deltapine 15	555.6	266.56	249.61	234.61	40.6	1 3/32	173
Fox	490.5	237.59	223.12	210.37	37.6	1 1/16	193
Plains	468.6	226.32	212.50	200.32	38.1	1 1/16	168
Miller	465.3	221.90	209.33	197.00	37.6	1	167
Coker, Staple	435.9	213.29	200.00	188.23	37.1	1 3/32	183
Delfos 651	431.2	217.81	202.93	188.06	36.0	1 1/8	191
Pandora	412.1	201.18	189.02	178.31	36.3	1 1/16	169
Coker, Wilt	411.2	201.09	188.55	177.45	37.2	1 3/32	176
Bobshaw 1A	395.8	189.85	178.18	168.88	38.4	1 1/32	182
Arkot 2-1	375.9	183.98	172.89	163.11	35.9	1 1/16	172
Delfos 9169	360.1	177.50	166.52	156.80	35.9	1 3/32	172
Stoneville 2492	357.4	173.42	162.88	153.59	37.3	1 1/16	164
Stoneville 2B	346.9	168.83	158.60	149.58	36.8	1 1/16	169
Bobshaw 1	344.2	169.01	158.85	149.90	35.4	1 1/16	190
Hi-Bred	336.3	149.35	143.63	136.90	41.2	7/8	152
Empire	307.2	149.52	140.46	132.47	36.8	1 1/16	163

HOLLY SPRINGS

Average results from cotton varieties, Holly Springs

	Pounds lint per acre					Averages 1946-1950				
	1946	1947	1948	1949	1950	Lint	Acre value	Staple inches	Lint per-cent.	Bolls per lb. lint
Delfos 9169	395.5	639.2	731.9	562.8	567.7	579.4	237.46	1 1/16	36.5	187
Coker, Staple	428.5	621.4	730.8	546.7	565.9	578.7	235.97	1 1/16	37.0	201
Coker, Wilt	432.2	622.8	703.1	513.8	573.2	569.0	231.23	1 1/16	37.3	192
Empire	444.8	620.0	707.9	564.6	502.2	567.9	227.61	1 1/16	37.8	169
Stoneville 2B	414.6	664.9	755.6	456.7	517.9	561.9	228.24	1 1/16	36.6	180
Deltapine 15	421.4	607.7	689.7	551.1	526.1	559.2	221.64	1 1/32	39.9	196
Miller	384.2	672.8	741.7	497.8	484.5	556.2	218.11	31/32	38.0	181
Hi-Bred	409.8	667.5	745.9	528.2	426.0	555.5	205.49	29/32	41.9	157
Delfos 651	353.0	639.8	675.1	496.3	478.1	528.5	216.68	1 1/16	35.6	212
Bobshaw 1	375.4	624.2	657.3	447.4	471.5	515.2	208.77	1 1/32	36.2	205

Cotton Varieties, Holly Springs, 1950

	Pounds lint per acre	Acre value seed and lint			Lint per-centage	Staple inches	Bolls per lb. lint
		Middling	Strict low middling	Low middling			
Plains	592.9	278.10	261.80	247.27	39.0	31/32	171
Coker, Wilt	573.2	275.25	258.35	244.87	38.2	1 1/32	167
Fox	572.0	276.13	259.25	245.81	37.3	1 1/32	198
Delfos 9169	567.7	276.81	260.06	245.30	36.5	1 1/16	179
Coker, Staple	565.9	274.28	257.58	242.87	37.5	1 1/16	183
Bobshaw 1A	534.5	251.86	237.17	224.07	38.2	31/32	192
Stoneville 2492	534.5	256.67	240.91	228.35	38.2	1 1/32	161
Arkot 2-1	528.2	257.39	241.81	228.07	36.6	1 1/16	180
Deltapine 15	526.1	248.60	234.40	220.46	39.2	1	185
Stoneville 2B	517.9	251.91	236.63	223.17	36.9	1 1/16	174
Pandora	502.4	242.25	227.43	215.62	37.5	1 1/32	176
Empire	502.2	242.28	227.46	214.41	38.3	1 1/16	153
Miller	484.5	226.21	213.13	202.23	38.5	15/16	169
Delfos 651	478.1	234.14	220.83	207.60	35.8	1 1/16	195
Bobshaw 1	471.5	229.15	215.24	204.16	36.2	1 1/32	191
Hi-Bred	426.0	187.48	180.88	172.57	41.2	27/32	147

BROOKSVILLE

Average results from cotton varieties, Brooksville

	Pounds lint per acre				Averages, 1948-1950			Bolls per lb. lint
	1948	1949	1950	Average	Acre value	Staple inches	Lint percentage	
Deltapine 15	229.9	669.9	357.8	415.2	162.24	1 1/16	40.4	202
Empire	196.8	654.7	335.5	395.7	154.97	1 1/16	37.7	174
Stoneville 2B	178.0	653.9	350.6	394.2	156.64	1 3/32	36.5	193
Delfos 651	179.8	592.8	360.0	377.5	151.86	1 3/32	35.8	222
Delfos 9169	181.7	640.8	301.5	374.7	147.93	1 3/32	36.1	207
Coker, Wilt	173.1	614.1	297.1	361.4	141.45	1 1/16	36.9	207
Miller	195.1	549.1	315.3	353.2	136.69	1	38.2	187
Hi-Bred	221.7	620.3	213.7	351.9	125.92	15/16	41.9	165
Coker, Staple	212.1	548.2	274.2	344.8	139.27	1 1/8	36.5	220
Bobshaw 1	176.2	529.7	327.6	344.5	137.97	1 1/16	36.2	208

Cotton varieties, Brooksville, 1950

	Pounds lint per acre	Acre value seed and lint			Lint percentage	Staple inches	Bolls per lb. lint
		Middling	Strict low middling	Low middling			
Fox	391.7	190.23	178.28	167.71	38.4	1 3/32	214
Plains	362.1	176.07	165.02	155.24	38.2	1 3/32	196
Delfos 651	360.0	176.80	165.82	156.10	36.5	1 3/32	214
Deltapine 15	357.8	171.92	161.01	151.35	40.4	1 3/32	207
Bobshaw 1A	355.7	170.62	160.13	151.77	38.4	1 1/32	207
Stoneville 2B	350.6	171.96	161.26	151.80	36.7	1 3/32	192
Arkot 2-1	343.1	168.91	158.44	149.18	36.1	1 3/32	190
Empire	335.5	160.92	151.02	143.14	38.4	1 1/32	173
Stoneville 2492	328.5	159.31	149.62	141.08	37.4	1 1/16	182
Bobshaw 1	327.6	160.88	150.89	142.05	36.5	1 3/32	201
Miller	315.3	149.75	141.24	132.88	38.3	1	187
Delfos 9169	301.5	148.33	139.14	131.00	36.2	1 3/32	198
Coker, Wilt	297.1	144.08	135.31	127.59	37.4	1 1/16	192
Coker, Staple	274.2	138.08	128.62	119.16	36.5	1 1/8	230
Pandora	269.6	130.90	122.95	115.94	37.2	1 1/16	189
Hi-Bred	213.7	97.83	92.06	87.25	42.2	15/16	161

NEWTON

Average results from cotton varieties, Newton, 1948-1950

	Pounds lint per acre				Averages, 1948-1950			Bolls per lb. lint
	1948	1949	1950	Average	Acre value	Staple inches	Lint percentage	
Empire	459.4	283.2	576.6	439.7	182.23	1 1/16	39.0	177
Deltapine 15	459.7	308.2	528.9	432.3	175.63	1 1/16	41.3	205
Stoneville 2B	498.8	267.3	518.3	428.1	179.71	1 1/16	38.0	189
Coker, Wilt	489.8	258.0	510.2	419.3	173.52	1 1/16	37.6	205
Bobshaw 1	471.9	245.1	532.6	416.5	174.77	1 1/16	37.0	204
Hi-Bred	515.4	273.6	420.3	403.1	145.75	7/8	43.0	162
Miller	501.6	191.4	495.5	396.2	162.09	1	38.5	192
Delfos 9169	450.8	232.7	474.3	385.9	163.52	1 3/32	37.6	201
Coker, Staple	450.4	180.6	463.9	365.0	155.48	1 3/32	37.6	216
Delfos 651	432.8	223.1	413.9	356.6	148.38	1 1/16	36.8	217

Cotton varieties, Newton, 1950

	Pounds lint per acre	Acre value seed and lint			Lint percentage	Staple inches	Bolls per lb. lint
		Middling	Strict low middling	Low middling			
Stoneville 2492	586.9	285.68	267.78	251.93	38.0	1 3/32	176
Empire	576.6	279.88	262.29	246.72	38.5	1 3/32	170
Bobshaw 1A	555.7	267.94	251.55	237.10	38.4	1 1/16	206
Bobshaw 1	532.6	261.07	244.83	230.45	36.8	1 3/32	189
Deltapine 15	528.9	255.20	239.07	224.79	39.6	1 3/32	207
Stoneville 2B	518.3	259.79	241.91	224.03	37.3	1 1/8	183
Plains	518.3	251.65	236.36	222.88	37.2	1 1/16	187
Fox	516.9	250.97	235.73	222.29	37.2	1 1/16	204
Arkot 2-1	516.5	259.95	242.13	224.31	36.6	1 1/8	180
Coker, Wilt	510.2	249.51	233.95	220.17	37.2	1 3/32	180
Miller	495.5	237.00	223.62	210.49	37.1	1	196
Delfos 9169	474.3	238.57	222.20	205.84	36.7	1 1/8	195
Coker, Staple	463.9	233.89	217.89	201.88	36.3	1 1/8	217
Pandora	463.9	226.33	212.65	200.58	36.4	1 1/16	191
Hi-Bred	420.3	186.17	179.02	170.61	41.7	7/8	156
Delfos 651	413.9	203.26	190.63	179.46	36.5	1 3/32	196

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Corn Hybrids and Varieties In Mississippi, 1950 Tests

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
FRANK J. WELCH, Director
STATE COLLEGE MISSISSIPPI

These corn tests are a cooperative project between the Mississippi Experiment Station and the Division of Cereal Crops and Diseases, Bureau of Plant Industry, Soils and Agricultural Engineering, and the Division of Cereal and Forage Insect Investigations, Bureau of Entomology and Plant Quarantine, Agricultural Research Administration, U. S. Department of Agriculture.

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B. C. Hurt, Jr., agronomist, Coastal Plain Branch Station, Newton.

T. E. Ashley, superintendent, South Mississippi Branch Station, Poplarville.

Four plantation trials included in these tests were made possible through the cooperation of J. O. Weber, Indianola; D. L. Edson, State Penitentiary Farm, Parchman; E. T. Schaffer, Yazoo City; and Harris Barnes, Jr., of Connell and Company, Sherard.

Corn Hybrids and Varieties

IN MISSISSIPPI, 1951 TESTS

Dixie hybrids led all other hybrids and varieties in the 1950 Mississippi hybrid corn performance tests. The five Dixie hybrids adapted to Mississippi took the top five places in yield in the average of twelve tests grown at experiment stations and plantations in the northern two-thirds of the state. The top-yielding hybrid in the South Mississippi test at Poplarville was a Dixie hybrid.

These corn performance tests designed to determine the most desirable strains, were continued in 1950 at State College, the seven branch experiment stations, and four farms in the Delta. The most promising hybrids sold in the state were compared with the best open pollinated varieties, new experimental hybrids, and a few of the poor hybrids offered for sale.

It is well recognized that open-pollinated varieties of corn differ greatly in adaptation and performance, and many farmers are learning that not all hybrids are superior to the best open pollinated varieties. Tests over a period of years have proved conclusively that the best adapted hybrids are superior to the best adapted open-pollinated varieties. Some hybrids, however, are unsuited for planting in Mississippi, particularly hybrids bred for conditions differing from those in the South. The corn performance tests of previous years have proved clearly that most northern hybrids are unsuited for use as full-season corns in the South because of poor yield, poor insect resistance, and poor quality.

Each test, except Poplarville, contained 25 entries arranged in a balanced lattice design with six replications. Each plot was two rows wide and 10 hills long with rows and hills spaced 40 inches apart. Five seeds were planted per hill and later thinned to two or three plants per hill (approximately 8,000 or 12,000 plants per acre). Tests at Poplarville, Hollys Springs, Brooksville, Newton and Oakley had 8,000 plants per acre and the remainder of the tests had 12,000.

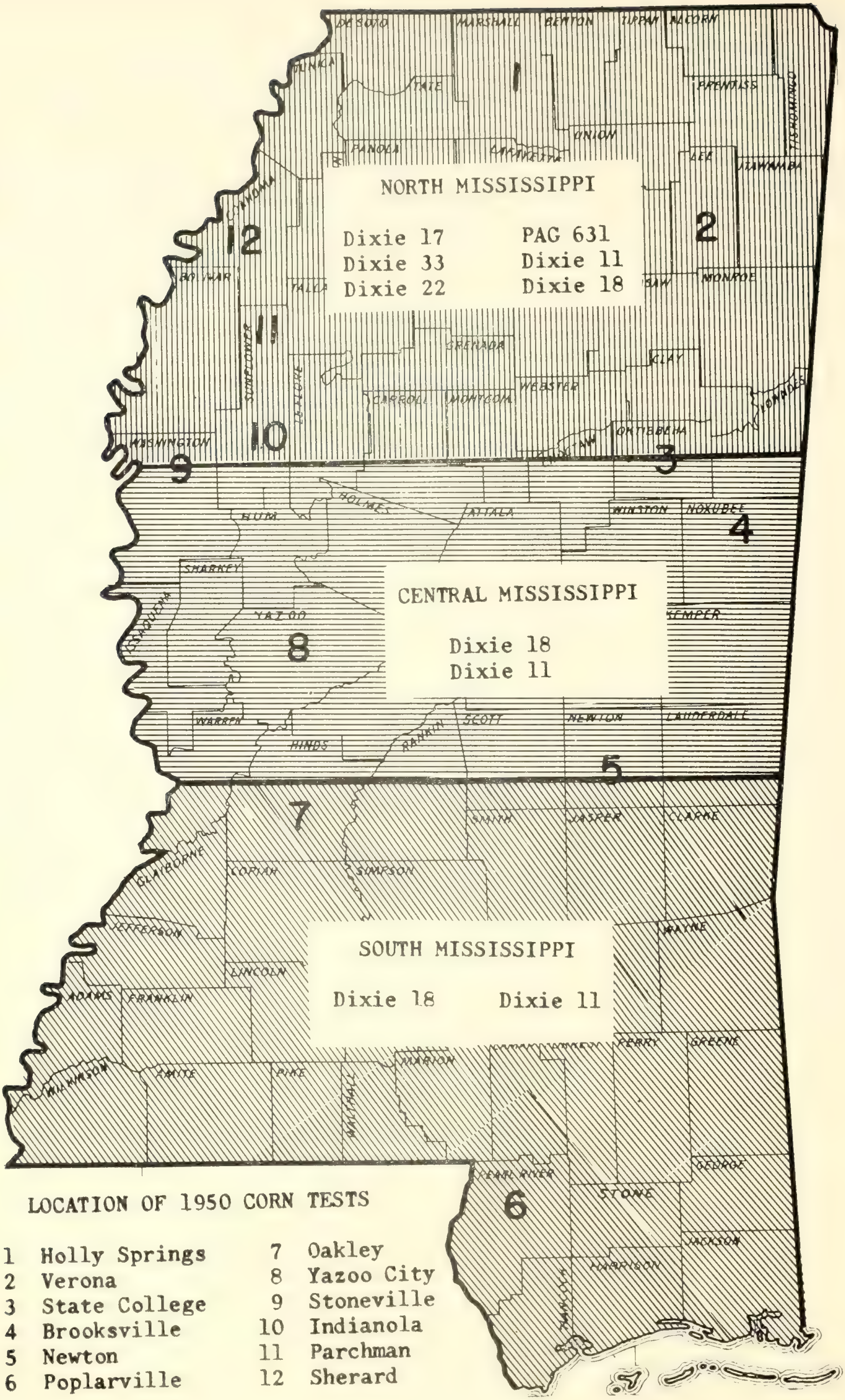
Moisture was a limiting factor in a number of tests and severely limited the yield in the test at Parchman. Although the total rainfall for the season appeared to be adequate for corn, most areas had at least one drouthy period which cut the yields appreciably.

Yields at State College are based on yields of shelled grain; at all other locations the yields are based on 70 pounds of husked earcorn per bushel. Any two kinds of corn should differ by at least the number of bushels shown opposite the notation "least significant difference" (5 percent level) before any great confidence can be placed on the two entries being really different in yielding ability.

Two- or three-year averages for yields are given in these tables where the tests have been run over a period of years. The yields based on a period of years for any one station are more reliable than one year yields and should be given great importance in picking out a hybrid for use on the farm.

The percentage of plants lodged is based on actual counts. All plants broken below the top ear-bearing node (joint) were classified as stalk lodged, while all plants leaning 30 degrees or more from the vertical were classified as root lodged.

Stalk lodging is usually much worse than root lodging when a mechanical corn harvester is used. Ears infested with earworm and rice weevils are shown in percent. Husk extension is reported in inches with no husk extension given a zero grade and a four-inch extension given a four grade. Ear height is the number of feet from the ground that the attachment of the top ear is placed. Ears


NORTH MISSISSIPPI
Dixie 17
Dixie 33
Dixie 22
PAG 631
Dixie 11
Dixie 18
CENTRAL MISSISSIPPI
Dixie 18
Dixie 11
SOUTH MISSISSIPPI
Dixie 18
Dixie 11
1
2
3
4
5
6
7
8
9
10
11
12
DE SOTO
MARSHALL
BENTON
TIPPAH
ALCORN
TUNICA
TATE
PRENTISS
TISHOMINGO
UNION
PANOLA
LAFAYETTE
LEE
ITAWAMBA
COAHOMA
BOLIVAR
TALLA
MONROE
SUNFLOWER
GRENADA
CLAY
LEFLORE
CARROLL
MONTGOM.
WEBSTER
LOWNDES
WASHINGTON
OKTIBBEHA
HUM.
HOLMES
ATTALA
WINSTON
NOXUBEE
SHARKEY
ISSAQUENA
YAZOO
KEMPER
WARREN
HINDS
RANKIN
SCOTT
NEWTON
LAUDERDALE
SMITH
JASPER
CLARKE
CLAIBORNE
COPIAH
SIMPSON
JEFFERSON
WAYNE
LINCOLN
ADAMS
FRANKLIN
PERRY
GREENE
WILKINSON
AMITE
PIKE
WALTHALL
MARION
PEARL RIVER
STONE
GEORGE
JACKSON
HARRISON
HANCOCK

LOCATION OF 1950 CORN TESTS

1 Holly Springs
2 Verona
3 State College
4 Brooksville
5 Newton
6 Poplarville
7 Oakley
8 Yazoo City
9 Stoneville
10 Indianola
11 Parchman
12 Sherard

Hybrid Recommendations

North Mississippi (North of U. S. Highway 82)

Dixie 17 (white)

Dixie 33 (white)

Dixie 22 (yellow)

PAG 631 (white)

Dixie 11 (white) southern counties

Dixie 18 (yellow) southern counties for cribbing.

Central Miss (North of U. S. Highway 80 and South of U. S. 82)

Dixie 18 (yellow)

Dixie 11 (white)

Dixie 17 (white) early feed or hogging off only.

Dixie 33 (white) early feed or hogging off only.

Dixie 22 (yellow) early feed or hogging off only.

PAG 631 (white) early feed or hogging off only.

Southern Mississippi (South of U. S. Highway 80)

Dixie 18 (yellow)

Dixie 11 (white) northern counties.

Georgia 281 (white) southern counties (limited amounts of seed).

Dixie 17 (white) early feed or hogging off only.

Dixie 33 (white) early feed or hogging off only.

Dixie 22 (yellow) early feed or hogging off only.

PAG 631 (white) early feed or hogging off only.

Silage Corn: Dixie 18 in all areas of Mississippi

per plant indicate whether the hybrid is single eared or prolific.

Shelling Percentage

The ratio of grain weight divided by the total weight of cobs and grain give a figure called shelling percentage. A shelling percentage of 86 means that from 100 pounds of ear corn, 86 pounds were grain and 14 pounds were cobs. Usually the large single-eared hybrids have more cob and less grain for each 100 pounds of ear corn than do the prolific hybrids. Dixie 11, 17, 18, and 33 all had shelling percentages of 86 percent or higher while the one-eared corn belt type hybrids such as PAG 170, DeKalb 1022 and DeKalb 1025 had shelling percentages of 82 percent. With 100 pounds each of Dixie 18 and DeKalb 1022, the Experiment Station got four pounds more of grain from Dixie 18 than DeKalb 1022. This indicates that a farmer selling corn of one of the prolific Dixie hybrids should sell it on the basis of 66 pounds of shucked ear corn to the bushel (68 pounds with the shuck on) when the moisture is 15.5 percent or lower instead of the 70 or 72 pounds used in the past. Adapted prolific southern hybrids shell out better than unadapted one-eared hybrids.

State-Wide Results

Twenty-five of the hybrids and varieties were planted at all locations except Poplarville where 16 hybrids and varieties were planted. The 12-station averages of the 25 entries are reported in table 1. Dixie 17, Dixie 33, Dixie 11, Dixie 22, and Dixie 18 were the top five hybrids in yield with an experimental Mississippi hybrid sixth and PAG 631 seventh.

Dixie 18, a yellow hybrid, was outstanding in many respects and should be widely grown in 1951 in all except the northern third of the state. Dixie 18 stood excellently, and had very few ears infested with rice weevil, had excellent quality

Table I. Average of twelve hybrid corn test in 1950 (omitting Poplarville).

Pedigree	Acre yield	Plants erect at harvest	Lodging		Ears infested		Ear ht.	Ears per[3] plant	Husk[4] length	Days to[2] 50% silk	Shelling[2]	Unsound[4] Ears	Stand
			Root	Stalk	Rice[1] Weevil	Ear-[2] worm							
	bu.	%	%	%	%	%	ft.	No.	in.	No.	%	%	%
Dixie 17	87.6	72	14	14	29	92	4.1	1.4	1.8	68	86	10	92
Dixie 33	84.1	79	16	5	51	98	4.2	1.2	1.6	66	86	20	92
Dixie 11	82.9	53	31	16	18	90	4.3	1.5	2.4	70	87	4	94
Dixie 22	80.9	78	13	9	33	94	4.1	1.2	2.2	68	84	17	91
Dixie 18	80.4	86	10	4	8	76	4.7	1.3	3.2	72	86	7	93
Miss. 9101	78.8	75	15	10	36	92	3.9	1.4	2.0	68	85	11	91
PAG 631	77.0	79	12	9	40	99	3.3	1.0	2.1	64	84	30	91
Coker Coastal 811	74.4	85	13	2	7	82	3.8	1.4	2.0	72	82	5	92
Miss. 9002	73.6	83	9	8	14	92	4.0	1.0	3.0	68	82	22	92
Miss. 0202	73.3	89	8	3	4	76	4.1	1.3	3.6	70	86	7	91
Funk G714A	72.6	63	22	15	25	89	4.0	1.4	2.8	70	86	12	90
Station Mosby*	72.4	65	20	15	33	93	5.0	1.1	2.1	72	83	16	93
Funk G711	72.2	66	9	25	44	99	3.7	1.1	1.0	67	84	28	90
Funk G780W	71.9	62	24	14	26	86	4.4	1.4	2.2	68	88	9	93
Funk G714	71.5	73	12	15	40	98	3.9	1.3	1.7	69	86	18	87
PAG 630	70.4	76	18	6	43	98	3.3	1.0	1.7	64	78	46	84
Funk G737	70.2	73	19	8	7	92	4.7	1.2	2.6	72	82	11	92
Miss. 0204	70.0	83	12	5	10	74	4.0	1.1	3.4	70	83	17	90
DeKalb 1025	68.7	60	16	24	56	100	3.7	1.0	1.0	67	82	30	90
Funk G720	68.8	75	17	8	29	93	4.4	1.1	2.1	70	84	16	92
Jellicorse*	68.8	70	19	11	38	92	3.6	1.2	1.5	68	84	16	85
Miss. 8006	68.6	80	11	9	11	87	3.8	1.0	2.8	69	85	20	90
DeKalb 1022	67.9	70	11	19	53	100	3.4	1.0	0.6	64	82	42	92
Jarvis*	59.6	65	23	12	17	92	3.3	1.2	1.7	67	89	21	85
PAG 170	59.5	84	11	5	65	100	3.1	1.0	0.8	62	82	29	88

*Open pollinated varieties.

[1] Three station average.

[2] Two station average.

[3] Ten station average.

[4] Four station average.

Table 2. Hybrid corn test at Poplarville, 1950.

Pedigree	Acre yield	3-Year average yield	Plants erect at harvest	Lodging		Ears infested		Ear ht.	Ears per plant	Husk length	Stand
				Root	Stalk	Rice Weevils	Ear worm				
	bu.	bu.	%	%	%	%	%	ft.	No.	in.	%
Dixie 18	60.6	51.0	87	1	12	37	65	3.7	1.1	3.2	93
Georgia 281	59.8		78	7	15	24	49	4.7	1.1	3.4	96
Coastal 811	59.6		92	2	6	37	56	3.0	1.1	2.4	95
Dixie 17	55.3	50.0	78	3	19	83	94	2.9	1.3	1.8	86
Miss. 0202	55.2		96	0	4	24	63	3.2	1.0	3.4	89
Funk G790W	54.6	46.8	69	4	27	50	63	4.2	1.0	2.4	93
Dixie 22	54.2		85	1	14	82	92	3.1	1.1	2.4	86
Funk G791W	52.6		68	4	28	29	54	3.5	1.0	3.0	90
Dixie 11	52.2	50.8	71	10	19	55	65	3.7	1.2	2.6	88
Miss. 0204	52.1		91	3	6	23	61	3.0	1.0	4.2	81
Station Mosby*	51.9	41.5	61	2	37	77	78	3.9	0.9	2.4	91
Funk G737	48.2	43.2	81	2	17	46	70	3.5	1.0	2.2	92
GCP 9105	48.0		83	4	13	38	68	3.5	1.1	3.6	84
Miss. 0101	46.5		91	3	6	68	84	4.2	0.9	2.2	58
Yellow Shoe Peg*	34.3		66	7	27	35	47	3.7	0.9	3.2	78
Pigott Red Cob*	30.0		60	27	13	20	39	4.3	0.8	3.2	84

A difference in yield of at least 7 bushels per acre is required to be considered significant.

*Open pollinated varieties.

grain, and yielded well in all parts of Mississippi. Dixie 18 has a long tight husk which is very necessary in South Mississippi for protection against rice weevils. Dixie 18 is recommended as a silage corn in all parts of the state and for grain in the southern two-thirds of the state. Under some conditions the ear attachment of Dixie 18 is rather high, but it is no higher than Mosby.

Another yellow hybrid, Dixie 22, had an excellent yield record averaging 80.9 bushels in the 12 tests. Dixie 22 stands better than any of the other adapted yellow hybrids with the exception of Dixie 18. Dixie 22 is adapted to the northern third of Mississippi and has the same area of adaptation as does Dixie 17. Dixie 22 has a husk extension of a little over two inches but the husk is not tight and, consequently, Dixie 22 cannot be used in heavy weevil areas except for hogging off and early feed. The ears of Dixie 22 are larger than those of Dixie 17 and some are a reddish yellow color. Dixie 22 worked well in mechanical harvesters in 1950 and is considered the best yellow hybrid for the northern part of the state.

As in past years, Dixie 17 was a very high yielding hybrid in the tests, yielding 87.6 bushels per acre compared to 84.1 bushels for Dixie 33, the next highest in yield. In 1949, Dixie 33 yielded slightly more than Dixie 17. Dixie 17, although very high in yield and sound ears, lodges excessively under some conditions. Dixie 33 stands better than Dixie 17 and this appears to be its only point of superiority. Dixie 17 is somewhat more resistant to rice weevils than Dixie 33 but neither hybrid is very resistant and

Table 3. Hybrid corn test at Holly Springs, 1950.

Pedigree	Acre yield	3-Year average yield	Plants erect at harvest	Lodging Root	Lodging Stalk	Ear ht.	Ears per plant	Stand
	bu.	bu.	%	%	%	ft.	No.	%
Dixie 33	68.7		48	44	8	4.4	1.4	102
Dixie 17	68.1	72.8	42	43	15	4.2	1.5	105
Dixie 22	67.4	71.6	51	30	19	4.3	1.3	103
Miss. 0202	62.3		76	19	5	4.3	1.4	102
Miss. 9101	61.7		64	20	16	4.2	1.5	100
PAG 631	60.0	62.4	63	11	26	3.6	1.0	95
PAG 630	59.1	60.7	63	24	13	3.5	1.1	93
Dixie 18	58.4		62	34	4	5.0	1.3	102
Funk G714A	58.4		31	32	37	4.4	1.5	96
Miss. 0204	58.0		65	28	7	4.1	1.2	98
DeKalb 1022	57.2		49	14	37	3.8	1.0	97
Miss. 9002	56.1		76	11	13	4.1	1.0	98
Funk G720	55.8	59.1	41	44	15	4.5	1.1	103
Dixie 11	55.4	62.0	17	47	36	4.7	1.5	98
Funk G714	55.3	62.7	46	22	32	4.1	1.3	98
Funk G711	55.2		40	11	49	4.1	1.0	100
Jellicorse*	54.7	60.2	49	30	21	4.1	1.4	94
Station Mosby*	54.4	57.6	27	45	28	5.0	1.2	105
PAG 170	54.1		60	28	12	3.6	1.0	94
Funk G780W	52.9		40	37	23	4.5	1.4	101
Miss. 8006	52.5		83	7	10	4.2	1.0	100
Coker Coastal 811	52.4		64	29	7	4.1	1.4	105
DeKalb 1025	52.1		25	14	61	4.3	1.0	91
Funk G737	50.8		46	39	15	4.8	1.2	99
Jarvis*	45.8		38	35	27	3.8	1.3	94

A difference in yield of at least 6.3 bushels per acre is required to be considered significant.
*Open pollinated varieties.

Table 4. Hybrid corn test at Verona, 1950.

Pedigree	Acre yield	3-Year average yield	Plants erect at harvest	Lodging Root	Lodging Stalk	Ears infested Earworm	Ear ht.	Ears per plant	Husk length	Stand
	bu.	bu.	%	%	%	%	ft.	No.	in.	%
Dixie 11	86.3	77.1	20	46	34	96	4.3	1.6	2.0	97
Dixie 18	85.6		85	11	4	83	4.4	1.4	3.0	96
Dixie 33	85.3		59	29	12	100	3.8	1.2	1.5	90
Dixie 17	84.7	77.2	44	20	36	98	3.9	1.4	1.2	93
Miss. 9101	82.0		40	27	33	93	3.8	1.5	1.8	93
Dixie 22	80.6	78.9	52	30	18	98	4.2	1.3	2.3	91
Miss. 0204	78.3		64	34	2	85	4.0	1.2	3.0	94
Coker Coastal 811	77.4		72	20	8	92	3.7	1.5	2.2	96
Station Mosby*	75.6	68.9	31	31	38	99	4.9	1.2	1.8	93
Miss. 0202	75.2		86	11	3	90	3.9	1.3	3.0	88
Funk G714A	73.4		36	36	28	94	4.1	1.4	2.7	91
Funk G780W	72.9		26	[illegible]	33	94	4.6	1.6	2.7	95
Miss. 9002	71.5		79	17	4	95	3.9	0.9	2.5	92
PAG 630	71.3	64.8	58	34	8	99	3.3	1.0	1.8	81
Funk G737	69.1		65	23	12	94	4.6	1.2	2.3	96
Funk G714	69.0	70.4	57	19	24	98	3.8	1.2	1.7	91
Funk G720	67.7	65.0	63	30	7	99	3.9	1.0	2.2	94
Funk G711	66.4		68	12	20	99	3.7	0.9	0.7	89
PAG 631	66.4	67.9	61	26	13	100	3.4	1.0	1.8	93
Miss. 8006	65.8		73	22	5	89	3.8	0.9	2.3	87
DeKalb 1025	65.8		40	19	41	100	3.9	1.0	0.8	95
DeKalb 1022	60.3		39	24	37	100	3.3	0.9	0.8	92
Jellicorse*	60.2	64.4	62	28	10	97	3.6	1.1	1.3	89
PAG 170	58.4		66	29	5	100	3.3	0.9	1.3	95
Jarvis*	57.4		45	37	18	98	3.3	1.2	1.8	89

A difference in yield of at least 7.5 bushels per acre is required to be considered significant.

*Open pollinated varieties.

Table 5. Hybrid corn test at State College, 1950

Pedigree	Acre yield	2-Year average yield	Plants erect at harvest	Lodging		Ears infested		Ear ht.	Ears per plant	Husk[1] length	Shelling	Days to 50% silk	Stand
				Root	Stalk	Rice[1] Weevil	Earworm						
	bu.	bu.	%	%	%	%	%	ft.	No.	in.	%	No.	%
Dixie 18	128.6	—	70	25	5	7	69	4.8	1.6	2.0	87	70	95
Dixie 17	120.9	116.5	47	33	20	21	85	4.2	1.6	2.0	87	67	96
Dixie 11	120.4	114.0	7	59	34	19	84	4.4	1.7	2.0	88	69	99
Dixie 22	114.9	110.0	60	32	8	38	91	4.2	1.3	2.0	84	67	99
Funk G780W	110.8	107.0	17	53	30	18	79	4.0	1.6	2.0	88	67	98
Miss. 9101	110.7	107.0	46	42	12	40	91	3.9	1.6	2.0	85	66	98
Dixie 33	110.3	109.8	67	28	5	66	96	4.1	1.2	1.7	86	63	97
Funk G714	104.6	99.6	59	26	15	44	97	3.8	1.3	2.0	87	68	95
Funk G737	104.5	—	45	45	10	6	90	4.8	1.4	2.0	83	72	98
Miss. 0202	103.5	—	85	8	7	3	62	4.2	1.4	3.0	87	69	91
PAG 631	103.0	98.3	80	15	5	49	98	3.2	1.0	2.0	84	63	96
Miss. 9002	102.4	—	67	17	16	15	88	4.1	1.0	3.3	84	67	96
Station Mosby*	102.3	99.6	29	49	22	27	87	4.8	1.2	2.3	86	71	94
Funk G714A	100.9	—	23	53	24	25	84	3.7	1.5	2.3	86	69	90
Miss. 8006	99.5	—	62	20	18	18	85	3.8	1.0	2.3	83	68	97
Jellicorse*	98.3	98.2	43	38	19	53	87	3.4	1.3	1.7	84	66	98
Miss. 0204	97.8	—	68	25	7	11	64	4.2	1.2	2.7	84	68	92
Funk G711	97.6	—	48	18	34	50	99	3.6	1.2	2.0	85	66	92
Funk G720	96.9	92.3	48	41	11	28	87	4.5	1.2	2.0	84	70	93
Jarvis*	95.8	—	36	43	21	13	85	3.3	1.4	2.0	90	66	96
Coastal 811	92.8	—	64	34	2	12	71	3.8	1.4	2.0	84	71	87
DeKalb 1025	89.1	85.7	27	35	38	74	99	3.5	1.0	1.7	84	66	96
DeKalb 1022	86.6	83.6	48	23	29	65	99	3.4	1.0	1.0	83	63	98
PAG 630	85.7	83.6	57	37	6	54	96	3.2	1.0	1.7	79	64	94
PAG 170	74.0	72.6	89	8	3	63	100	3.0	1.0	1.0	84	62	95

A difference in yield of at least 8.2 bushels per acre is required to be considered significant. *Open pollinated varieties. [1]Three replications only.

should be grown for grain only in the northern third of the state. Both hybrids are excellent for hogging off in any section of the state.

Dixie 11 is a white hybrid adapted to the central part of Mississippi. The percent of sound ears was the highest of any hybrid in the tests. The weevil resistance is better than Dixie 17 but poorer than Dixie 18. Dixie 11 root lodges badly under some conditions but it is the only high yielding commercial white hybrid of high quality grain adapted to Central Mississippi. Funk G78OW has excellent quality white grain but it is not as resistant to rice weevil, and yields 13 percent less than Dixie 11 and approximately the same as Station Mosby.

PAG 631 is a relatively high yielding single-eared white hybrid adapted to the northern part of Mississippi. PAG 631 yielded especially well in some of the Delta tests but its main fault was in the high percent of ears with rotten butts. As in past years PAG 631 has performed better than PAG 630 and much better than PAG 170, a corn belt type hybrid of very low yield.

Coker's Coastal 811 is a new white hybrid that promises to do well in central and southern Mississippi. It is very resistant to lodging, has about the same good resistance to rice weevils as Dixie 18 and has hard grain of high quality. The main disadvantage is the small size of its ears. There will be little or no seed available to Mississippi farmers for the 1951 planting.

The Funk G hybrids all yielded about the same as Station Mosby and Jellicorse.

Table 6. Hybrid corn test at Brooksville, 1950.

Pedigree	Acre yield	3-Year average yield	Plants erect at harvest	Lodging		Ears infested rice weevil	Ear ht.	Ears per plant	Stand
				Root	Stalk				
	bu.	bu.	%	%	%	%	ft.	No.	%
Dixie 22	74.9	58.5	97	1	2	17	4.6	1.2	89
Dixie 17	72.4	57.7	97	1	2	19	4.2	1.4	87
Dixie 33	68.6		94	5	1	28	4.3	1.2	84
Funk G711	67.2		82	5	13	26	4.1	1.0	93
Miss. 9101	67.0		93	5	2	38	4.2	1.2	95
Dixie 11	66.6	56.2	76	21	3	10	4.5	1.4	100
Funk G714A	66.5		75	22	3	19	4.2	1.3	93
PAG 631	66.2	49.6	88	6	6	28	3.5	1.0	93
Dixie 18	63.2		99	1	0	7	4.8	1.2	93
Funk G714	62.4	49.4	92	5	3	35	4.1	1.1	89
Jellicorse*	62.2	48.7	91	7	2	24	4.2	1.2	92
DeKalb 1022	62.2		89	6	5	28	3.8	1.0	89
DeKalb 1025	62.0		82	7	11	40	4.1	1.0	87
Funk G737	61.7		89	9	2	6	4.9	1.1	91
Coker Coastal 811	61.4		96	4	0	2	3.8	1.2	85
Miss. 9002	61.4		93	3	4	8	4.4	0.9	85
Funk G780W	61.2		78	16	6	29	4.7	1.1	97
Miss. 0202	60.4		96	3	1	4	4.3	1.2	89
Miss. 0204	59.9		95	4	1	2	4.2	1.0	89
Station Mosby*	59.7	47.1	78	16	6	22	5.0	1.1	88
Miss. 8006	58.8		91	5	4	1	4.2	0.9	87
PAG 630	58.8	44.8	90	9	1	32	3.6	1.0	83
Funk G720	58.7	47.5	93	5	2	23	4.3	1.0	92
Jarvis*	54.6		91	6	3	6	3.6	1.2	95
PAG 170	49.3		96	1	3	51	3.2	1.0	85

A difference in yield of at least 5.4 bushels per acre is required to be considered significant.
*Open pollinated varieties.

Table 7. Hybrid corn test at Newton, 1950.

Pedigree	Acre yield	3-Year average yield	Plants erect at harvest	Lodging		Ears infested Rice Weevil	Ear ht.	Ears per plant	Husk length	Stand[1]
				Root	Stalk					
	bu.	bu.	%	%	%	%	ft.	No.	in.	%
Dixie 17	53.9	51.7	74	3	23	47	3.9	1.3	2.0	99
Dixie 33	51.8		94	1	5	58	4.1	1.1	1.3	101
Dixie 18	49.6	45.4	99	0	1	11	4.4	1.1	3.3	104
Miss. 9101	49.5		91	4	5	31	3.4	1.1	2.3	98
Dixie 22	48.5		88	2	10	45	3.5	1.0	2.3	100
Miss. 0202	48.4		95	0	5	4	3.7	1.0	4.0	104
Miss. 0204	47.3		82	2	16	18	3.8	1.0	3.7	100
Miss. 9002	46.9		88	0	12	20	3.1	1.0	3.3	105
Dixie 11	46.7	47.8	76	11	13	25	4.0	1.2	2.7	105
Funk G711	46.7		53	1	46	57	3.3	1.1	0.8	99
Coker Coastal 811	46.2		97	3	0	8	3.7	1.2	2.0	98
Funk G714A	46.0		79	4	17	30	3.9	1.2	3.3	108
Jellicorse*	45.5	41.9	88	5	7	38	3.5	1.2	1.3	89
Station Mosby*	45.5	41.1	80	9	11	50	4.9	1.0	2.3	101
PAG 630	45.4	43.9	87	1	12	43	3.0	1.1	2.0	92
Funk G780W	45.1		75	12	13	31	3.9	1.1	2.0	103
DeKalb 1022	45.0		79	1	20	66	3.2	0.9	0.3	108
PAG 631	44.5	43.5	89	0	11	43	2.8	0.9	2.3	103
Miss. 8006	44.1		81	0	19	15	3.1	0.9	3.7	101
Funk G720	43.8	42.0	87	4	9	35	4.4	1.0	2.3	104
Jarvis*	43.1		83	10	7	32	3.1	1.2	1.7	95
Funk G714	42.4	41.4	86	1	13	40	3.5	1.1	1.3	89
Funk G737	41.0		83	5	12	10	3.9	1.0	3.3	104
DeKalb 1025	37.9		66	3	31	55	3.5	0.9	1.3	92
PAG 170	36.8		97	0	3	81	2.8	1.0	0.8	94

A difference in yield of at least 5.1 bushels per acre is required to be considered significant.

*Open pollinated varieties.

[1] Two plants per hill considered 100 percent stand.

Funk G711, tested for the first time in Mississippi has no husk extension and is very susceptible to stalk breaking. Funk G714 and G714A had as much stalk breaking as Dixie 17 and yielded 17 percent less grain.

Several experimental hybrids looked promising especially Miss. 0202 which is 75 percent the same as Dixie 18. Miss. 0202 stood better and had less weevil ears at harvest than Dixie 18. However, no seed is available for planting in 1951.

Poplarville

The data from the test at Poplarville are shown in table 2. Dixie 18 was first in yield in 1950 and for the three-year period 1948-1950. Dixie 18 is the outstanding yellow hybrid at Poplarville, in yield, in weevil resistance, and in lodging resistance. Dixie 18 made almost double the yields of the local open-pollinated varieties, Yellow Shoe Peg and Pigott Red Cob, and stood much better at harvest. Pigott Red Cob had a lower percent of ears infested with weevils but it is not recommended because of its very low yield.

Georgia 281, a new white hybrid for the Gulf Coast area, yielded well and is resistant to rice weevils, but lodges more than Dixie 18 and has a high ear attachment. Very little seed of Georgia 281 will be available for the 1951 plantings.

Individual Tests

Tables 2 through 14 present the data from the individual tests. No one test can tell the whole story on a hybrid because of differences in environment. At

Table 8. Hybrid corn test at Oakley, 1950.

Pedigree	Acre yield	2-Year average yield	Plants erect at harvest	Lodging		Ear ht.	Ears per plant	Husk length[1]	Stand
				Root	Stalk				
	bu.	bu.	%	%	%	ft.	No.	in.	%
Dixie 17	82.8	63.6	74	19	7	4.5	1.8	2.0	88
Funk G714A	77.3		55	39	6	4.4	1.8	2.7	82
Miss. 9101	77.2	60.8	71	25	4	4.3	1.6	2.0	88
Dixie 33	73.5	56.9	69	27	4	4.4	1.5	2.0	87
Dixie 22	72.1	61.0	79	18	3	4.6	1.4	2.0	78
Dixie 11	71.8	59.0	28	66	6	4.5	1.9	3.0	85
Funk G711	70.8		73	16	11	4.1	1.3	0.7	91
Funk G714	70.7	52.5	69	21	10	4.7	1.7	1.7	83
Dixie 18	69.0	55.6	94	4	2	5.3	1.4	4.7	83
DeKalb 1025	67.9	53.4	49	42	9	4.3	1.2	0.0	86
Coker Coastal 811	65.3		86	12	2	4.3	1.6	2.0	80
Station Mosby*	65.1	49.8	45	46	9	5.6	1.3	2.0	90
Funk G737	64.3		62	34	4	5.2	1.5	3.0	85
Miss. 0204	62.9		88	10	2	4.2	1.3	4.3	81
Funk G720	62.8	49.6	73	25	2	4.5	1.3	2.0	79
Funk G780W	62.2	51.2	42	48	10	4.4	1.6	2.3	85
Miss. 0202	61.7		90	9	1	4.7	1.5	4.3	91
DeKalb 1022	61.4		70	21	9	3.7	1.2	0.3	78
Jellicorse*	61.4	49.7	57	32	11	4.0	1.6	1.7	66
Miss. 9002	61.1		78	19	3	3.9	1.1	3.0	80
Miss. 8006	56.5	49.0	74	24	2	3.8	1.1	2.7	77
PAG 631	53.1	42.7	56	36	8	3.8	1.2	2.3	69
PAG 630	51.7	43.8	61	34	5	3.2	1.1	1.3	66
Jarvis*	48.2		37	57	6	3.7	1.6	1.3	58
PAG 170	44.6	35.0	77	21	2	3.3	1.0	0.0	68

A difference in yield of at least 8.3 bushels per acre is required to be considered significant.

*Open pollinated varieties.

[1] Three replications only.

one location, conditions may be such that little or no lodging occurred and weevil damage was heavy. At that location little can be told about lodging resistance but excellent information was gathered on weevil resistance. The better producing hybrids yield near the top irrespective of location. Thus a number of tests in one year may give as much or more information than the same number of tests at one location over a period of years.

The average (table 1) of the twelve tests gives much information about the various attributes of each hybrid and variety. This table should be studied thoroughly along with the test on the station or farm nearest your farm. By use of these tables, you should be able to make a good choice of hybrids for your 1951 corn plantings.

Table 9. Hybrid corn test at Yazoo City, 1950.

Pedigree	Acre yield	3-Year average yield	Plants erect at harvest	Lodging		Ear ht.	Stand
				Root	Stalk		
	bu.	bu.	%	%	%	ft.	%
Dixie 33	119.8		83	7	10	5.1	95
Dixie 17	112.4	88.9	62	6	32	5.0	86
Dixie 11	112.1	97.5	73	12	15	5.0	84
Coastal 811	109.4		97	1	2	4.5	93
Dixie 18	107.8	87.3	88	5	7	5.8	86
PAG 631	104.7	82.5	84	3	13	3.7	90
Miss. 9101	104.5		82	4	14	4.8	89
Miss. 0202	102.3		89	2	8	5.1	86
Miss. 9002	99.9		79	3	17	4.8	93
Dixie 22	99.8		77	1	22	4.6	82
Station Mosby*	98.2	72.5	65	11	24	6.3	90
Funk G737	96.8		74	6	20	5.7	87
DeKalb 1022	92.5		52	5	43	3.8	95
Funk G780W	90.0		67	7	26	5.4	90
DeKalb 1025	89.9		58	9	32	4.2	90
Funk G720	89.9	73.1	81	3	16	5.6	90
Miss. 8006	88.9		80	3	18	4.3	85
Funk G711	88.6		40	4	56	4.0	88
Funk G714	88.4	72.6	54	5	40	4.3	78
Funk G714A	88.1		67	8	25	4.8	84
Jellicorse*	87.8	71.3	72	5	24	3.9	85
PAG 630	84.8	75.3	88	6	6	3.7	79
Miss. 0204	81.5		86	1	12	4.5	82
PAG 170	80.1		79	6	14	3.3	85
Jarvis*	70.9		59	8	33	3.8	79

A difference in yield of at least 12.5 bushels per acre is required to be considered significant.
*Open pollinated varieties.

Table 10. Hybrid corn test at Stoneville, 1950

Pedigree	Acre yield	3-Year average yield	Plants erect at harvest	Lodging		Earworm[1] damage	Ear ht.	Unsound[1] ears	Ears per[1] plant	Days to silk	Shelling per-centage[1]	Quality at harvest	Stand
				Root	Stalk								
	bu.	bu.	%	%	%	Score[2]	ft.	%	No.	%	No.	score[3]	%
Dixie 17	111.0	101.1	89	1	5	2.0	4.5	9.1	1.5	85	69	2.3	95
Coastal 811	103.0	....	98	2	0	1.0	4.1	5.5	1.6	80	72	2.0	91
PAG 631	101.8	91.6	99	1	0	2.0	4.0	28.6	1.0	83	65	4.3	91
Dixie 11	97.9	93.3	80	19	1	1.0	4.6	3.4	1.7	86	71	1.7	92
Dixie 22	96,8	90.7	99	0	1	2.0	4.7	14.1	1.2	83	70	3.0	84
Dixie 33	96.3	....	100	0	0	3.0	4.3	17.1	1.3	85	68	4.3	89
Station Mosby*	93.3	85.2	83	14	3	2.0	5.7	14.6	1.1	80	73	3.0	95
Funk G711	92.2	....	90	2	8	3.3	3.7	22.9	1.1	84	68	4.7	86
Miss. 9002	91.5	....	98	1	1	1.3	4.2	23.2	1.0	79	70	2.7	96
Dixie 18	91.2	....	100	0	0	1.0	5.0	11.2	1.2	85	73	1.7	92
Funk G780W	90.8	....	88	12	0	1.0	4.7	7.6	1.5	87	70	2.0	94
Miss. 9101	89.9	....	97	3	0	2.0	4.0	10.1	1.4	85	69	3.0	87
Miss. 8006	88.9	....	99	0	1	2.0	4.2	14.3	1.0	87	70	3.0	89
Jellicorse*	88.0	77.0	94	5	1	2.0	3.7	18.4	1.3	84	70	3.7	87
Funk G720	87.8	81.7	92	8	1	2.0	4.9	15.7	1.1	83	71	2.7	88
Funk G737	87.0	....	90	10	0	1.3	5.1	8.1	1.3	82	73	2.0	91
PAG 630	87.0	78.3	89	11	0	3.0	4.0	42.8	1.1	76	65	4.7	87
Miss. 0204	86.6	....	99	0	1	1.0	4.1	18.1	1.1	82	72	2.3	91
Miss. 0202	86.5	....	98	2	0	1.0	4.1	9.4	1.2	86	72	1.7	91
Funk G714	86.2	78.3	94	4	2	2.3	4.2	17.3	1.5	84	70	2.7	85
DeKalb 1025	86.0	....	88	7	5	3.0	3.8	28.3	1.0	80	68	5.0	91
DeKalb 1022	85.6	....	96	2	2	3.0	3.6	36.7	1.0	82	65	5.0	94
Funk G714A	81.2	....	93	6	1	1.3	4.1	10.2	1.4	85	71	2.0	83
Jarvis*	79.5	....	87	11	2	2.0	3.5	21.6	1.3	88	68	3.3	85
PAG 170	66.8	....	99	0	1	3.3	3.6	27.0	1.1	80	62	5.0	83

*Open pollinated varieties.

[1] Data on three replications.

[2] Score: 0 = no damage, 4 = severe damage.

[3] Score: 1 = excellent, sound, clean; 5 = poor, rot, weevils, etc. A score of 3 is considered acceptable.

Table 11. Hybrid corn test at Indianola, 1950.

Pedigree	Acre yield	2-Year average yield	Plants erect at harvest	Lodging Root	Lodging Stalk	Earworm damage[1]	Ear ht.	Unsound ears[1]	Ears per[1] plant	Stand
	bu.	bu.	%	%	%	score[2]	ft.	%	No.	%
Dixie 17	69.6	71.5	49	29	22	2.0	3.0	14.5	1.1	80
PAG 631	69.2	72.4	54	29	17	2.0	3.0	35.4	1.0	85
Dixie 18	67.6		46	34	20	1.0	3.7	9.2	1.1	86
Miss. 8006	67.5	67.0	48	34	17	1.5	3.2	31.6	.9	86
Dixie 11	67.0	66.1	28	33	38	1.0	3.7	6.4	1.1	92
Miss. 9002	65.4		55	26	18	2.0	3.2	20.0	.9	87
PAG 630	65.2	70.0	39	42	18	2.0	3.0	54.5	1.0	75
Dixie 22	65.1	74.1	46	35	19	2.0	3.4	30.2	.9	79
Dixie 33	65.0	73.0	44	46	11	2.0	3.7	35.7	.9	79
Miss. 0202	63.9		56	40	4	1.0	3.5	9.2	1.2	77
Coastal 811	62.5		58	38	4	1.0	3.2	7.7	1.1	88
Miss. 9101	61.9	64.2	38	39	23	2.0	3.1	18.3	1.1	90
Miss. 0204	60.9		57	36	8	1.0	3.7	26.7	.9	89
Funk G737	60.2		47	35	18	1.0	4.0	15.5	1.1	87
Funk G714	58.8	65.4	49	26	25	2.5	3.4	22.6	.9	83
Funk G780W	57.9	62.9	47	29	24	1.5	3.8	17.3	1.1	80
Station Mosby*	55.6	55.0	37	39	24	2.0	4.0	20.4	.9	85
Funk G711	55.3		37	24	39	3.0	3.2	40.9	1.0	81
Funk G714A	55.0		43	29	28	2.0	3.3	20.8	1.0	84
DeKalb 1022	54.8	55.6	46	24	30	3.0	3.0	56.2	.9	88
Funk G720	54.1	63.8	49	33	18	2.0	3.3	18.8	.8	85
Jellicorse*	52.6	56.6	33	41	26	2.0	3.0	23.9	.9	67
DeKalb 1025	49.0	58.2	34	24	42	3.0	2.9	32.5	.9	78
Jarvis*	44.2		37	48	15	2.0	2.8	29.0	1.0	78
PAG 170	39.7	48.0	56	34	11	3.0	2.8	43.0	.9	88

A difference in yield of at least 7.9 bushels per acre is required to be considered significant.

*Open pollinated varieties.

[1] Data on two replications.

[2] Score: 0=no damage, 4=severe damage.

Table 12. Hybrid corn test at Parchman, 1950.

Pedigree	Acre yield	Plants erect at harvset	Lodging		Ear ht.	Stand
			Root	Stalk		
	bu.	%	%	%	ft.	%
PAG 631	57.1	96	2	3	2.7	87
Dixie 17	53.0	97	1	2	3.2	92
Dixie 33	51.5	98	1	1	3.2	88
Dixie 22	46.3	100	0	0	3.1	92
PAG 170	45.7	97	1	2	2.7	84
PAG 630	45.5	95	2	2	2.8	78
Dixie 11	43.1	93	1	6	3.3	89
DeKalb 1025	43.0	93	3	4	2.9	84
Funk G711	42.0	93	3	4	3.1	82
Funk G714	40.4	92	4	4	3.3	74
Dixie 18	39.0	99	0	1	3.6	89
Miss. 9101	37.9	97	2	2	2.8	72
Funk G714A	37.5	96	1	3	2.9	82
Miss. 0202	36.4	97	2	1	3.3	86
Coastal 811	35.9	99	0	0	3.1	91
Miss. 8006	35.1	97	1	2	3.1	87
Station Mosby*	34.6	92	4	5	3.7	86
Miss. 9002	34.2	99	1	1	3.1	82
Miss. 0204	33.0	96	2	2	3.2	83
Funk G780W	32.5	95	1	4	3.4	84
DeKalb 1022	32.1	97	2	2	2.6	80
Funk G720	30.6	98	1	1	3.7	88
Funk G737	30.3	98	1	1	3.7	86
Jellicorse*	30.0	95	3	3	2.7	73
Jarvis*	24.7	94	2	4	2.4	75

A difference in yield of at least 9.9 bushels per acre is required to be considered significant.
*Open pollinated varieties.

Table 13. **Hybrid corn test at Sherard, 1950, on Sandy Soil.**

Pedigree	Acre yield	Plants erect at harvest	Lodging		Earworm[1] damage	Ear ht.	Unsound[1] ears	Ears per[1] plant	Stand
			Root	Stalk					
	bu.	%	%	%	score[2]	ft.	%	No.	%
Dixie 11	99.2	60	36	4	0.5	4.0	2.4	1.5	93
Miss. 9002	93.1	98	1	1	0.8	4.1	14.0	0.9	94
Dixie 17	93.0	91	7	2	1.0	4.0	6.8	1.3	92
Dixie 22	91.2	96	3	1	1.0	4.1	7.7	1.1	97
Dixie 33	89.6	93	6	0	1.0	4.4	12.7	1.1	97
Miss. 9101	87.8	95	5	1	1.0	4.1	6.9	1.2	92
PAG 631	86.7	90	8	2	1.5	3.2	19.6	1.0	93
PAG 630	84.4	87	11	2	2.0	3.2	41.0	1.0	86
Funk G714A	83.9	77	20	2	1.0	3.8	6.8	1.4	90
Dixie 18	83.8	98	1	1	0.3	4.2	4.1	1.1	91
Jellicorse*	80.2	70	24	6	1.0	3.5	12.7	1.2	88
Station Mosby*	79.6	64	34	2	1.0	4.8	12.0	1.0	94
Funk G720	79.5	89	10	2	0.8	4.2	16.7	1.0	94
Funk G780W	79.4	77	22	1	1.0	4.5	4.3	1.2	93
Funk G714	78.3	83	11	6	1.0	3.7	11.7	1.2	87
Coastal 811	77.5	92	8	0	0.5	3.8	2.5	1.1	93
DeKalb 1025	76.4	75	18	7	2.0	3.5	28.6	0.9	90
Miss. 0204	76.0	93	6	1	0.3	4.1	11.3	1.0	91
Funk G711	75.9	80	10	10	2.0	3.8	21.2	0.9	88
Miss. 8006	75.2	91	7	2	0.8	3.8	17.3	0.9	88
DeKalb 1022	74.7	87	7	5	2.5	3.2	34.6	0.9	94
Funk G737	74.2	89	10	0	0.8	4.4	8.6	1.0	92
Miss. 0202	73.8	96	3	1	0.3	4.0	5.0	1.0	95
PAG 170	73.4	98	2	0	3.0	3.1	28.3	1.0	92
Jarvis*	67.8	82	14	4	1.0	3.1	11.8	1.0	83

A difference in yield of at least 9.3 bushels per acre is required to be considered significant.

*Open pollinated varieties.

[1] Data on two replications.

[2] Score: 0=no damage, 4=severe damage.

Table 14. Hybrid corn test at Sherard, 1950, on clay soil.

Pedigree	Acre yield	Plants erect at harvest	Lodging		Earworm[1] damage	Ear ht.	Unsound[1] ears	Ears per[1] plant	Stand
			Root	Stalk					
	bu.	%	%	%	score[2]	ft.	%	No.	%
Dixie 17	129.2	90	6	5	1.0	4.4	8.9	1.6	94
Dixie 33	128.7	97	2	1	1.0	4.6	16.2	1.4	96
Dixie 11	128.0	76	21	4	0.3	4.6	3.4	1.7	99
Dixie 18	121.1	91	8	2	0.1	5.2	3.4	1.5	98
Miss. 9101	115.8	93	5	2	1.0	4.2	9.1	1.5	94
Dixie 22	113.8	93	4	2	1.0	4.3	15.4	1.2	95
PAG 631	110.7	95	3	2	1.0	3.2	34.9	.9	95
Coastal 811	109.5	100	0	0	0.1	4.0	4.8	1.4	97
Funk G711	109.1	83	4	13	2.0	3.8	29.0	1.2	91
Funk G780W	107.0	88	8	4	0.5	4.9	5.2	1.6	97
DeKalb 1025	105.8	82	7	11	1.5	3.9	29.4	1.1	94
PAG 630	105.8	95	3	2	2.0	3.6	44.8	1.0	92
Jellicorse*	105.3	87	6	7	1.0	3.7	10.5	1.3	91
Station Mosby*	105.3	65	29	6	0.8	5.7	17.3	1.1	95
Miss. 0202	104.8	97	2	1	0.1	4.6	2.7	1.4	94
Funk G714A	102.6	74	18	8	0.5	4.4	9.6	1.4	94
Funk G737	102.4	92	6	2	0.3	5.8	12.8	1.2	94
DeKalb 1022	101.9	88	5	7	2.0	3.5	38.6	1.2	87
Funk G714	101.7	87	5	8	1.0	4.1	18.5	1.4	91
Miss. 9002	100.3	88	8	4	0.8	4.7	31.0	1.0	92
Miss. 0204	98.2	95	2	2	0.5	4.4	13.0	1.2	93
Funk G720	98.1	91	2	7	1.0	4.9	14.5	1.1	92
Miss. 8006	90.7	84	7	9	0.3	4.5	16.2	1.0	95
PAG 170	90.6	94	3	3	2.5	3.0	18.9	1.0	91
Jarvis*	83.1	86	9	5	1.0	3.4	20.9	1.2	94

A difference in yield of at least 8.8 bushels per acre is required to be considered significant.

*Open pollinated varieties.

[1] Data on two replications.

[2] Score: 0=no damage, 4=severe damage.

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Mississippi Cooperative Gins

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
FRANK J. WELCH, Director
STATE COLLEGE MISSISSIPPI

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MISSISSIPPI COOPERATIVE GINS

By B. K. DOYLE and R. W. SHAW

Introduction

Cotton gins comprise the largest group of cooperative enterprises in Mississippi. At the time this study began there were approximately 225 farmer cooperatives in the state, with 82 of these being cotton gins. This development might be expected since cotton is the leading farm enterprise and ginning, as the first step beyond production of cotton, is eaily integrated into the farm operations of a group of producers. Also, the investment required in establishing and operating a modern gin is far too great for the average producer to undertake, except for the large plantations.

The cooperative cotton gin movement in Mississippi was motivated largely by the dissatisfaction of cotton producers with services and charges of custom ginners. Many producers felt that the rates charged for ginning cotton were out of line with the costs involved for providing such services. Another reason for the gin development was the belief of many farmers that they were suffering substantial losses as a direct result of damage to their cotton during the ginning process. This damage and loss, they believed, resulted primarily from poor ginning equipment and negligent management. A final important factor to be considered was the practice of mechanical harvesting of cotton and the necessity for additional equipment to do a good job of ginning. These factors stimulated groups of producers to band themselves together in order to finance the new changes in ginning needed to meet this process and receive the desired services.

In an effort to bring about the desired changes in ginning practices and costs, the cotton producers and individuals within the state, with the aid of both government and private financial agencies, began to organize and operate cooperative cotton gins.

The Problem

This study is an effort to appraise the organization and operation of cooperative gins, to determine their financial status, and to ascertain the cost of performing the ginning function by these plants. The cost phase is being utilized as a part of the Southern Regional Cotton Marketing Project in the determination of the overall cost of marketing. The entire study will be included also in a nation-wide project on cooperative cotton gins, being conducted by the Cooperative Research and Service Division, Farm Credit Administration, United States Department of Agriculture.

One of the objectives of this report is to make recommendations that will result in improvements in the organization and operation of cooperative gins. These recommendations are based upon practices dealing with captial structure, dividend payments, management policies, and membership relations. It is hoped that the results of the cost section of this study will enable gin operators, both cooperative and others, to appraise their operations in light of the recommendations made here and make adjustments leading to relatively lower cost for ginning.

Scope and Method

Records were obtained from 42 of the 82 cooperative gins in the state. This represented 52 percent of those in the Delta and 47 percent for the Upland. It is felt that this sample is representative of the organization of all cooperatives and make

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The Cotton and Oilseed Section, Cooperative Research and Service Division, Farm Credit Administration, United States Department of Agriculture, cooperated in the collection of data for this study.

possible the computation of accurate cost data for ginning. Gins included in the study were located in both Upland and Delta areas of the state so that differences in type-of-farming areas and operating procedures are taken into account.

The survey method was used in obtaining the desired information. The schedule was prepared by the Cooperative Research and Service Division, Farm Credit Administration. Certain changes were introduced to make the questions applicable to the situations existing in Mississippi. Cost and financial data were supplied to the enumerators from audited balance sheets and operating statements.

Organization And Operation Of Cooperative Gins

All of the cooperative gins studied were capital stock associations. This type of organization differs from the organization of non-stock associations only in that the former issues capital stock to show evidence of investment of capital. Non-stock associations issues certificates of equity, certificates of indebtness, or book credits.

Cooperative gins are started by a group of farmers organizing and purchasing capital stock equal to amounts necessary for down payments on, or outright purchases of gins. These stock issues were mainly preferred stock. The number of shares and value of common stock was held to a small percentage of the total. In most cases, stock was bought only by producers of cotton and in amounts that were in direct relation to the cotton acreage or some other measure. Using such as basis tended to make capital outlay in direct relation to the amount of service that would be demanded by the patron or member in the future. After the association began operation, additional capital was obtained by requiring the purchase of capital stock as new producers were given membership. Capital was also obtained by issuing capital stock in lieu of payment of patronage refunds. This stock, which was issued to both member and non-meber patrons, was usually preferred stock. In no case was common stock issued to non-member patrons. In those instances where no preferred stock was issued, non-member patrons were usually given book credits as evidence of ownership. In several associations, which isued both common and preferred stock, book credits, usually called capital contributions, were used to keep down payment of stock dividends. The latter method applied to both member and non-member patrons.

Even though Mississippi law gives each share of capital stock voting power, the associations usually follow the "one man, one vote" principle when choosing officers and other members of the board of directors, and in the operation of the associations. In a few cases, voting was done by stock when a decision could not be reached by the "one-member, one vote" method, particularly in the decision of major importance such as expansion or contraction of services.

The board of directors has the responsibility of hiring association managers and other personnel. It also outlines operating policies such as gin charges and other fiscal matters. The manager in most cases in the Delta is hired as a plant superintendent while some member of the board assumes responsibility of day-to-day business decisions. In the Upland area, the board is the policy group and a manager is hired to make the day-to-day business decisions. This may be accounted for by the year-round operation of these associations, since they carry on both ginning and purchasing activities.

In Mississippi the difference between a member and a patron is small, since the agricultural association law gives non-member patrons rights equal to member patrons in the distribution of earnings of the association. Non-member patrons have no voting rights in selecting officers or in expansion or contraction of services and other business decisions.

Thirty-four of the 42 cooperative gins included in this study, were located in the 8 major cotton-producing counties of the Delta—Sunflower, Coahoma, Tallahatchie, Bolivar, Leflore, Quitman, Washington, and Humphreys. The remaining 8 were located in the Upland counties of Newton, Neshoba, Madison, Scott, Simpson, and Union.

Date of Organization and Renovation

Forty-four percent of those gins located in the Delta and seven of the eight gins located in the Upland began operation during the 5-year period, 1936 to 1940 (table 1). The oldest gin in this study was located in the Delta and began operation in 1912. The oldest association in the Upland was organized during the period 1913-1931.

Ninety-seven percent of the cooperative gins in the Delta have been completely rebuilt or overhauled within the past 15 years. In the Upland, seven of the eight gins studied have been completely renovated during this period. Almost 50 percent of the gins in the Delta and 25 percent of the gins in the Upland have been renovated within the past 5 years. All of the gins undergo routine annual maintenance which consist of such repairs as the sharpening of saws, replacement of broken saws, mending of broken belts, and other adjustments and repairs. It was observed that the management of the associations took a great deal of pride in maintaining their machinery in the best possible condition.

Capital Structure

Twenty-two gins in the Delta had both common and preferred stock, 6 had only common stock, and the remaining 6 had only preferred stock. In the Delta, par value of common stock was usually much lower than par value of preferred stock. Only 22 percent of the gins that issued common stock authorized a par value greater than $10, while 59 percent of the gins that issued preferred stock authorized a par value of over $10 (table 2).

None of the associations in the Upland area issued common stock with a par value of more than $10. Fifty percent of the associations in this area issued preferred stock with a par value of more than $10.

Only one of the gins in the Delta authorized payment of 6 percent dividend on common stock. Six gins in this area

Table 1. Number and percent of cooperative gins beginning operation during indicated periods, and the date of renovation of gin plants, Mississippi, 1948-49 season.

Year	Delta				Upland			
	Began operations		Rebuilt or completely overhauled		Began operations		Rebuilt or completely overhauled	
	No.	Percent	No.	Percent	No.	Percent	No.	Percent
1911-1915	1	3	--	--	--	--	--	--
1916-1920	--	--	--	--	--	--	--	--
1921-1925	--	--	--	--	--	--	--	--
1926-1930	1	3	1	3	--	--	--	--
1931-1935	4	12	--	--	1	12	1	12
1936-1940	15	44	7	21	7	88	5	63
1941-1945	11	32	12	35	--	--	--	--
1946-1948	2	6	14	41	--	--	2	25
Total	34	100	34	100	8	100	8	100

authorized payment of 8 percent dividend on common stock. With only one exception common stock was issued by those gins paying this high a dividend rate, and in this case both common and preferred stock were issued. Also common stock in this association was a greater proportion of the total stock issued than in the case of the other gins in the study. Twenty-one associations in this area paid no dividends on common stock. One gin in each area issued common stock with no par value. None of the associations in the Upland paid interest on common stock issued by their associations. In the majority of cases, common stock was only used as a requirement of membership rather than a means of raising capital; therefore, the associations did not feel that it was necessary to pay dividends on this type of stock.

In the majority of the cases the original capital used to establish the association was obtained through the sale of preferred stock. Approximately 76 percent of the associations which issued preferred stock in the Delta authorized the payment of 8 percent dividend on their preferred stock, and 24 percent of the associations within this area authorized 6 percent dividend on this type of stock (table 3). Seven of the eight associations in the Upland paid 6 percent dividend on their preferred stock, and the remaining one paid 8 percent.

The payment of a dividend on stock, in those instances where service is furnished non-members who do not contribute their proper share of the investment, serves as a means by which the non-member pays the member for the use of his capital investment. It also serves this purpose in those cases where members received services out of proportion to their capital investment. When the non-members are required to contribute a certain amount of capital in the form of capital contributions[1], or are issued capital stock in lieu of patronage refunds, the payment of stock dividends appear unnecessary other than as a means of raising the original capital or for additional capital for expansion.

None of the associations included in study had provisions for the retirement of stock. This is one of the more obvious weaknesses of the associations' capital structure. It is entirely possible for the non-participating members to become

Table 2. Number of cooperative gins issuing common and preferred stock of indicated par value, Mississippi, 1948-49 season.

Par value (dollars)	Number of gins issuing common stock		Number of gins issuing preferred stock	
	Delta	Upland	Delta	Upland
1.00	3	1	--	--
5.00	1	1	--	1
10.00	17	5	11	3
20.00	1	--	--	--
25.00	--	--	7	4
50.00	1	--	2	--
100.00	4	--	7	--
No common	6	--	6	--
No preferred	--	--	--	--
No par	1	1	1	--
Total	34	8	34	8

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[1] Capital contributions—a sum of money withheld from patronage refund for capital purposes. Book credits are given to the individual patron as evidence of ownership. These credits have first claim on all assets in event of liquidation.

Table 3. Number and percentage of cooperative gins authorizing indicated dividends for common and preferred stock, Mississippi, 1948.

Maximum dividend	Common stock				Preferred stock			
	Delta		Upland		Delta		Upland	
	No.	Percent	No.	Percent	No.	Percent	No.	Percent
Six percent	1	3	--	--	7	24	7	88
Eight percent	6	21	--	--	21	76	1	12
No dividend	21	76	8	100	--	--	--	--
Total	28	100	8	100	28	100	8	100

strong enough to divorce management from the association, and to divert emphasis from service to the members to profit for the associations, thereby insuring continued payment of dividends to themselves. In the absence of a definite stock rotation plan, the member who withdraws from the association has no guarantee as to when the investment that he has in the association will be forthcoming. It is possible, in the event the association is faced with a period of economic instability, that the non-participating members may not receive either their investment or dividend on this investment for a number of years.

From the member's point of view, the absence of a definite stock rotation plan may burden him with needless dividend expense. This results from the failure of stock held by the non-participating member to revert back to the association at the time of his withdrawal. A five-or-ten-year stock rotation plan would eliminate most of these inequities.

In one association common stock was owned by non-producers and in 5 association preferred stock was owned by non-producers. Several explanations were given, but the one most often expressed was the failure to provide for compulsory retirement of stock in the by-laws of the association. It was quite evident from the interviews that little emphasis was placed upon the retirement of stock.

Requirements to Become Stockholders or Members

The requirements for membership were liberal in all cases. The only capital requirement was the purchase of one share of common stock. No association placed

Table 4. Number and percent of cooperative gins having indicated number of members, Mississippi, 1948.

Number of common stockholders or members	Delta		Upland	
	Number	Percent	Number	Percent
10-29	15	44	--	--
30-49	10	29	--	--
50-69	6	18	--	--
70-89	--	--	--	--
90-109	--	--	--	--
110-129	--	--	--	--
130-149	1	3	--	--
150-169	1	3	--	--
170-189	--	--	1	12
190-209	--	--	2	25
210-229	--	--	--	--
229 and above	1	3	5	63
Total	34	100	8	100

Table 5. Number and percent of cooperative gins having indicated portions of membership as patrons, Mississippi, 1948-49 season.

Percent patrons of gin were of total ownership	Delta		Upland	
	Number	Percent	Number	Percent
Less than 24	--	--	--	--
25 to 49	2	6	--	--
50 to 74	5	15	1	12
75 to 99	4	12	3	38
100	23	67	4	50
Total	34	100	8	100

any limitation on size of business of a producer. All of the associations stated that a 10-bale producer would be accepted as quickly as a 100-bale producer. Without exception, the associations required that the member hold title to the cotton. No association placed any limitations on the race of its members. The majority of associations formed by white producers had few, if any, colored members. This may be partially explained by the limitation mentioned above, i. e., that a member must hold title to his product. The one association included in the study that was formed by Negroes had no white members.

All associations paid a portion of their patronage dividends in cash and, therefore, it was permissible for non-members to pay for the share of common stock required for membership with patronage refunds. Membership was granted at the close of the fiscal period. This method was used widely and made it relatively easy for the individual patron to meet the membership requirement. Only two gins included in the study had systems whereby all patrons were in the process of becoming members of the association. In these two cases the stock was isued in token of membership without the approval of the patron. It was assumed by the management that those who patronized the gin knew that they would be expected to accept the responsibilities of membership, if they were to receive the ginning service of the association.

To become a member in 24 of the associations it was necessary to obtain the approval of the board of directors. In the remaining associations, although approval by the board was not required, the members of the board were informed of the request for membership by the secretary of the association.

It should be pointed out as a desirable practice, that the requirements governing acceptance of new members should be

Table 6. Number and percent of cooperative gins having indicated portions of patrons attending annual meetings, Mississippi, 1948-49 season.

Percent attending meetings	Delta		Upland	
	Number	Percent	Number	Percent
Less than 24	3	9	2	25
25 to 49	2	6	4	50
50 to 74	5	15	1	13
75 to 99	12	35	1	12
100 and over[1]	10	29	--	--
No annual meeting	2	6	--	--
Total	34	100	8	100

[1] Additional attendance due to non-member patrons attending meetings.

specifically stated in an association's bylaws. Then no exception should be allowed to the specified requirements.

Only in approximately one-fourth of the associations did the minutes of the board meetings show, by name and date, when the new members were accepted. In the other case the only record was the issuance of stock.

Members

Slightly over 90 percent of the gins in the Delta had less than 70 members or common stockholders. None of the gins in the Upland had less than 170 members (table 4).

There appears to be a very high degree of correlation between location and size of membership. The gins located in the Delta have consistently small membership, while the gins located in the Upland have consistently a very large membership. This was due to differences in size of farm, system of farming, and services performed by the association in the two areas.

Patronage

A little over two-thirds of the total number of gins in the Delta had 100 percent patronage by their total membership during the 1948-49 season. Only 2 gins included in this area had less than one-half of their total membership as patrons (table 5).

Four of the eight gins in the Upland had all members patronizing the association. None of the associations in this area had less than 50 percent of its members using the service offered.

Attendance at Annual Meetings

Approximately 64 percent of the gins in the Delta had over three-fourths of total membership at the annual meetings during the 1948-49 season. Only 12 percent of the associations in the Upland had more than 75 percent of their total membership present at their annual meetings (table 6).

Directors

The number of directors comprising the board in the associations varied from 4 to 12. Approximately 44 percent of the gins in the Delta maintained 4 or 5 members on their boards of directors. Approximately 35 percent of the association in this area had boards comprised of 7 members. The remaining 21 percent of the associations had boards of 8 to 12 members. Fifty percent of the gins located in the Upland had boards of 7 members and the remaining associations had boards of 9 members (table 7). All except one of the associations in the Delta elected directors each year, and they could be re-elected by members. Sixty-three percent of the associations in the Upland did not specify how often elections were to be held. The

Table 7. Number and percent of cooperative gins having indicated number of directors, Mississippi, 1948.

Number of directors	Delta		Upland	
	Number	Percent	Number	Percent
4	1	3	--	--
5	14	41	--	--
6	--	--	--	--
7	12	35	4	50
8	2	6	--	--
9	3	9	4	50
10	1	3	--	--
12	1	3	--	--
Total	34	100	8	100

Table 8. Number and percent of cooperative gins electing directors at indicated frequencies, Mississippi, 1948.

Frequency of election of directors	Delta		Upland	
	Number	Percent	Number	Percent
Each year	33	97	3	37
Staggered[1]	1	3	--	--
No definite period	--	--	5	63
Total	34	100	8	100

[1] A part of the directors are elected for varying time periods so that the Board may always have experienced directors.

remaining 37 percent within this area elected directors each year (table 8).

Approximately 80 percent of the gins in the Delta and 50 percent within the Upland area held from 1 to 5 formal directors' meeting during the year of 1948 (table 9). The remaining associations included within this study held from 6 to 20 formal directors' meetings during this period.

These regular meetings were supplemented with informal conferences held throughout the year. All directors and managers were free to call the entire board at any time. From the discussion at the time of interview, it was quite evident that a very close working relationship existed among the directors of most of the gins. This was due, at least in part, to the length of service that many had given (table 10).

Managers

Over 50 percent of the gin managers employed by the associations in the Delta had less than 5 years experience as managers of cotton gins, and almost 50 percent had been with the association less than 5 years (table 11). Seventy-five percent of the managers employed by the associations in the Upland had less than 10 years experience, and approximately 65 percent of these had less than 5 years previous experience.

Over 25 percent of the associations in the Delta paid a managerial salary between $1,000 and $2,000. Only 1 association in this area paid over $4,000 per year, and 4 of the associates paid less than $400 per year. Two of the eight associations in the Upland paid their managers less than $1,000 per year, and the remaining six did not disclose the salary paid (table 12).

In several cases the president or another officer was assigned the duty of managing the gin with little or no remuneration. The position of manager of a cooperative gin, as in other business concerns, is one of vital importance. This fact should be made clear to the associations and an effort should be made to impresss upon the members of the association that adequate

Table 9. Number and percent of cooperative gins having indicated numbers of directors' meetings, Mississippi, 1948-49 season.

Number of meetings	Delta		Upland	
	Number	Percent	Number	Percent
1-5	28	82	4	50
6-10	3	9	3	38
11-15	2	6	1	12
16-20	1	3	--	--
Total	34	100	8	100

Table 11. Number of managers of cooperative gins having indicated length of experience at present plant and previous experience as gin managers, Mississippi, 1948-49 season.

Length of experience, years	Managers' experience at present gin				Managers having previous experience			
	Delta		Upland		Delta		Upland	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
0-5	22	65	2	25	14	41	5	64
6-10	8	23	4	50	4	12	1	12
11-15	3	9	2	25	2	6	--	--
16-20	1	3	--	--	--	--	1	12
20 and over	--	--	--	--	14	41	1	12
Total	34	100	8	100	34	100	8	100

funds spent to obtain the services of a competent person to fill this position would be one of the best investment that the association could make.

Auditing and Accountants

A majority of the associations retained the services of a full-time bookkeeper and in addition obtained the services of a reputable auditing firm. Several associations hired the auditing firm to perform all of the association's bookkeeping. In these instances only a skeleton set of records was maintained at the gin plant. The auditing firms served all of the associations in an advisory capacity and were available to the associations at all important meetings of the board of directors or, if requested, at annual meetings. It was evident that the associations made use of the best auditing service available.

Marketing Practices Of Cooperative Gins

The gins included in this study received the majority of their income from the charges for ginning, sale of bagging and ties, purchase and sale of cottonseed and other purchasing activities. The other purchasing activities were confined primarily to those gins located in the Upland area.

The methods followed in levying charges and practices followed in the purchase and sale of cottonseed and of farm supplies are presented in the following discussion.

Table 12. Number and percent of cooperative gins paying indicated salaries to gin managers, Mississippi, 1948-49 season.

Salary (dollars)	Delta		Upland	
	Number	Percent[1]	Number	Percent[1]
0-499	4	17	--	--
500-999	2	8	2	100
1000-1499	6	25	--	--
1500-1999	5	21	--	--
2500-2999	4	17	--	--
3000-3499	--	--	--	--
3500-3999	2	8	--	--
4000 & above	1	4	--	--
Total reporting	24	100	2	100
No data	10	--	6	--
Total	34	--	8	--

[1] Based on the number actually reporting the salary.

Table 10. Number and percent of cooperative gins having major officers with indicated length of service, Mississippi, 1948-49 season.

Length of service	Delta						Upland					
	President		Vice President		Secretary		President		Vice President		Secretary	
years	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
1-4	11	32	14	42	14	42	2	25	4	50	3	38
5-9	7	21	8	23	11	32	5	62	3	38	2	25
10-14	16	47	11	32	8	23	1	13	1	12	3	37
15-19	--	--	1	3	--	--	--	--	--	--	--	--
20-24	--	--	--	--	--	--	--	--	--	--	--	--
25 & above	--	--	--	--	1	3	--	--	--	--	--	--
Total	34	100	34	100	34	100	8	100	8	100	8	100

Ginning Charges

The charges made for ginning varied from 25 to 75 cents per hundred pounds of seed cotton in the Delta, and from 25 to 55 cents per hundred in the Upland, for the two years studied (table 14). This variation in range of charges between the 2 areas may be explained by the fact that none of the gins in the Upland offered rates covering snapped or mechanically-harvested cotton.

Approximately 90 percent of the gins located in the Delta made only one flat charge in the 1947-48 season regardless of the method of harvest (table 13). Only 4 of the gins included in this study for this season made additional charges for cotton harvested by methods other than hand-picked. Three of these 4 gins made an additional charge for snapped cotton and one made an extra charge for mechanically-harvested cotton. The proportion of the gins making only one flat ginning charge remained approximately the same in the 1948-49 season, except that the number of gins that made an additional charge for mechanically-harvested cotton increased to three. According to information gathered at the time of interview with the gin managers, this change was due primarily to the fact that cotton harvested by mechanical pickers has a tendency to "rope" and become quite difficult to gin. Many of the ginners expressed the belief that in time this technological problem would be solved and thereby eliminate the differential in the gin charge.

No ginning charge differential due to method of harvest was found in the Upland because all of the cotton grown in this area was harvested by hand.

Bagging and Ties

Charges made for bagging and ties varied from $2.50 to $4.00 per bale in the Delta, and from $2.50 to $3.25 in the Upland for the season of 1947-48 (table 15). For the 1948-49 season, while the range

Table 13. Number of Cooperative gins making indicated variations in ginning charges on basis of method of harvesting, Mississippi, 1947-48, 1948-49 seasons.

Item	1947		1948	
	Number of Gins			
	Delta	Upland	Delta	Upland
One charge only	29	8	27	8
Extra charge for snapped	3	--	4	–
Extra charge for machine harvested	1	--	3	–
Total	33	8	34	8

remained approximately the same, 50 percent of the gins in the Delta charged $3.25 or more.

The tendency to increase the average charge was also evident in the Upland area.

Purchase of Seed

All of the associations included in this study purchased the cottonseed from the patrons.

Only 8 of the associations had mechanical seed scales. All of these associations were located within the Delta. The other 34 associations in both areas used a dockage formula to determine the weight of the cottonseed contained in each bale of cotton. The seed cotton was weighed prior to ginning. After ginning, the bale of lint was weighed and subtracted from the weight of the seed cotton. An additional 30 to 50 pounds was deducted as an allowance for loss in weight due to trash embodied in the seed cotton. This dockage figure was increased throughout the ginning season as the cotton became dirtier due to weather conditions.

The majority of the associations, both in the Delta and the Upland, based the day-to-day price paid for seed on an average price quoted by the oil mill to which they sold the seed. The majority of the gins did not operate on a fixed spread. Instead they depended upon the premiums paid by the mills for grade and moisture content and the gain in weight of the seed, for their margins on their seed operations. Three, or about 10 percent of the associations, followed a price set by the community in their seed-purchasing oprations. This frequently necessitates heavy

Table 14. Number of Cooperative gins making indicated charges for ginning, Mississippi, 1947-48, 1948-49 seasons.

Dollars per 100 lbs. of seed cotton	Delta						Upland					
	Hand picked		Snapped		Machine harvested		Hand picked		Snapped		Machine harvested	
	1947	1948	1947	1948	1947	1948	1947	1948	1947	1948	1947	1948
	Number of gins											
.25	2	2	2	2	--	--	2	2	--	--	--	--
.30	1	1	1	--	--	--	--	--	--	--	--	--
.35	1	1	1	1	--	--	2	1	--	--	--	--
.40	6	6	5	----	--	--	4	4	--	--	--	--
.45	8	8	6	4	1	1	--	--	--	--	--	--
.50	15	15	13	22	4	7	--	1	--	--	--	--
.55	----	----	----	----	--	--	--	--	--	--	--	--
.60	----	----	----	1	--	2	--	--	--	--	--	--
.65	----	----	1	1	1	1	--	--	--	--	--	--
.70	----	----	----	----	--	--	--	--	--	--	--	--
.75	----	----	2	2	--	1	--	--	--	--	--	--
Total	33	34	31	33	6	12	8	8	--	--	--	--

dockage in order for the gin to break even on its seed operations.

Sale of Seed

In the Delta, during the 1948-49 crop season, 18 percent of the associations used commerical oil mills entirely as an outlet for their seed, 21 percent of the associations used cooperative oil mills entirely and 29 percent used both cooperative and commerical oil mills. Only 9 percent of the associations sold to manufacturing organizations. The remaining 23 percent sold to terminal oil mills (table 16).

In the Upland, for this period, only one of the eight associations sold to a cooperative oil mill. The remaining seven sold exclusively to commerical oil mills. This may be attributed to the lack of cooperative oil mills in the Upland area.

Those gins within both areas that sold to cooperative oil mills received 80 percent of the sales price upon delivery and the remaining 20 percent at the close of the fiscal year. In instances where the mill's fiscal year did not coincide with the gin's, the gin held the oil mill refund and distributed it the following year to the members who owned the seed.

Sixty-five percent of the associations in the Delta accepted the prevailing price for seed (table 17). Twenty-seven percent negotiated for a price either before purchase of lots of seed or after buying large quantities of seed, and only 8 percent operated on a fixed spread of 3 to 5 dollars per ton.

In the Upland for this same period, 50 percent of the associations sold at the prevailing price, and 37 percent negotiated price before purchase of seed. Only one association within this area operated on a fixed spread.

In those cases where price was negotiated, the cooperative management was acting on a speculative basis. It should be emphasized that this is very dangerous business and the cooperative association should be discouraged from entering into such practices.

Other Purchasing Activities

The 8 Upland gins included in this study maintained active purchasing associations and in most instances the gin-

Table 15 Number of cooperative gins making indicated charges for bagging and ties, Mississippi, 1947-48, 1948-49 seasons.

Charges, dollars per bale	Delta 1947	Delta 1948	Upland[1] 1947	Upland[1] 1948
	Number of gins			
2.50	10	2	2	..
2.75	8	5	2	1
3.00	10	10	2	4
3.25	1	2	1	2
3.50	3	10		--
3.75	..	3	-	--
4.00	1	2	--	--
Total	33	34	7	7

[1] One gin included in the Upland area made no separate charge for bagging and ties.

Table 16. Number and percent of cooperative gins having indicated sales outlets for cotton seed, Mississippi, 1948-49 season.

Sales outlets[1]	Delta Number	Delta Percent	Upland Number	Upland Percent
Cooperative oil mills	7	21	1	12
Commercial oil mills	6	18	7	87
Terminal oil mills	8	23	.	--
Manufacturing organizations	3	9	--	--
Cooperative and commercial oil mills	10	29	--	--
Total	34	100	8	100

[1] Manufacturing organizations refer to such concerns as Swift and Company and wholesale grocery firms.

Table 17. Number and percent of Cooperative gins using indicated methods of negotiating price of seed at time of sale, Mississippi, 1948-49 season.

Method of negotiating price	Delta		Upland	
	Number	Percent	Number	Percent
Prevailing price	22	65	4	50
Negotiate price after collection of seed	5	15	3	37
Negotiate price prior to collection of seed	4	12	--	--
Fixed spread	3	8	1	13
Total	34	100	8	100

ing operation had become a less important activity as far as scope and operation was concerned.

This shift in importance is easily explained when one considers the importance of volume in the operation of a cotton gin. In all cases, the gins with the active purchasing departments were located in the Upland, an area of relatively few large cotton producers and a very low volume per gin stand. This was the major factor in the development of purchasing associations which have enabled the cooperative gins of this section to reduce the charge for ginning. Purchasing activities have increased in this area in performance of services to farmers in the last few years. The 3 major products handled by these associations were cottonseed meal, cottonseed hull, and fertilizer. Two of the associations operated feed mills in addition to their other operations and one association had a large fertilizer mixing plant.

Later discussion will show that these Upland associations have been very successful in the development of cooperative farm supply agencies. This type of operation offers definite possibilities for lowering the cost of ginning operations in the Delta area and opportunity for increased services to members.

Financial Status Of Mississippi Cooperative Gins

Capital Investment

Advance in technology of harvesting and ginning cotton increased the amount of capital required for the installation and operation of a cotton gin. At the present time the capital requirements are extremely large in contrast to gin investments of a decade ago. This is quite evident from the fact that the average gin in the Delta included in this study, reported total assets of $64,000 at the close of the 1948-49 crop season, an increase of about $7,000 over the 1947-48 season (table 18 and 19),

The average total assets controlled by the gins located in the Delta ranged from $43,000 for the average 3-stand gin to $109,000 for the average gin with 6 stands or more, during the 1948-49 season, and from $35,000 to $93,000 for these gins during the preceding season, This relationship existed throughout the entire breakdown of assets with the exception of current assets. Here the range narrowed with the 3-stand gins holding almost one-half as many current assets as the gins with 6 or more stands,

At the close of the 1948-49 season, the average gin in the Upland controlled total assets amounting to $93,000, an increase of $19,000 over the 1947-48 season. In the Upland, the total assets ranged from $50,000 for the gins with 4 stands or less to $165,000 for the gins with 5 stands and over, during the 1948-49 season, and from $47,000 to $119,000 during the pre-

Table 18. 1947-48 balance sheet, cooperative gins, Mississippi

	DELTA					UPLAND		
	All gins	3 stands	4 stands	5 stands	6 stands or more	All gins	4 stands or less	5 stands or more
	32	3	20	6		8	5	3
	Average per gin							
	$	$	$	$	$	$	$	$
Current assets								
Cash	10,741.95	9,784.66	9,305.29	14,249.92	13,381.21	10,448.59	9,489.94	12,046.35
Accounts receivable patrons	638.66	445.88	503.15	1,123.10	734.03	3,051.71	3,183.36	2,832.28
Accounts receivable other	8,456.38	3,170.17	9,138.39	6,022.93	12,661.18	3,050.48	3,504.61	2,293.59
Notes receivable	52.97	--------	29.27	193.78	--------	1,776.57	300.00	4,237.53
Other assets	41.19	--------	64.81	10.51	--------	99.37	158.98	--------
Inventory	2,528.95	897.24	1,905.60	4,828.06	3,420.83	20,307.60	7,683.13	41,348.40
Total current assets	22,460.10	14,297.95	20,946.51	26,427.30	30,197.25	38,734.32	24,320.02	62,758.15
Fixed assets:								
Cost of fixed assets	44,426.93	32,461.46	36,677.59	49,695.39	84,241.85	51,322.46	33,004.93	81,850.25
Res. for depreciation	12,281.70	12,843.18	9,185.82	12,746.60	26,641.79	21,954.77	14,014.86	35,187.59
Total fixed assets (book value)	32,145.23	19,618.28	27,491.77	36,948.79	57,600.06	29,367.69	18,990.07	46,662.66
Other assets:								
Prepaid expense	418.09	156.15	475.02	366.75	406.89	466.96	469.85	462.15
Organization expense	56.18	29.69	49.68	93.53	52.50	46.65	1.50	121.91
Stock in other organizations	2,236.48	665.00	2,300.29	895.53	5,107.43	2,895.67	3,386.29	2,077.95
Investments, gov't bonds, etc.	--------	--------	--------	--------	--------	2,500.01	--------	6,666.60
Total other assets	2,710.75	850.84	2,824.99	1,355.81	5,566.82	5,909.30	3,857.64	9,328.61
Total assets	57,316.08	34,767.07	51,263.27	64,731.90	93,364.13	74,011.31	47,167.73	118,749.42

LIABILITIES								
Current Liabilties:								
Accounts payable patrons	14.269.93	8,967.65	13.869.91	19,517.25	12,372.01	15,528.46	17.824.58	11,701.47
Accounts payable others	1,605.58	2,363.72	1,350.38	2,695.25	677.88	3,230.05	3,532.10	2,726.61
Notes payable	1,365.49		2,103.55	499.98		655.02		1,746.68
Accrued expense	660.31	141.66	666.66	599.53	1,109.13	934.14	496.12	1,664,18
Total current liabilities	17,901.31	11,473.03	17,990.50	23,312.01	14,159.02	20,347.67	21,852.80	17,838.94
Long-term liabilities:								
Mortgage payable	5,259.77		3,946.52	11,773.15	6,000.00	4,841.96	3,450.11	7,161.84
Notes payable	1,912.66	3,000.00	2,604.74	337.19				
Total long-term liabilities	7,172.43	3,000.00	6,551.26	12,110.34	6,000.00	4,841.96	3,450.11	7,161.84
Total liabilities	25,073.74	14,473.03	24,541.76	35,422.35	20,159.02	25,189.63	25,302.11	25,000.78
NET WORTH								
Reserves:								
Reserve for future distribution	1,536.82	594.67	1,359.35	1,401.01	3,334.42			
Reserve for contingencies	426.86	35.70	385.80	22.45	1,532.18	1,022.21	1,635.53	
Reserve for operation	1,091.16	817.08	391.76	623.69	5,494.87			
Reserve for replacement	300.03		495.05					
General reserves	1,106.73	1,158.57	1,218.15		2,170.84			
Total reserves	4,461.60	2,606.02	3,850.11	2,047.15	12,532.31	1,022.21	1,635.53	
Capital:								
Common stock	3,703.94	4,479.95	1,825.36	11,791.03	383.75	1,706.25	2,156.44	955.92
Preferred stock	20,210.51	12,314.87	16,718.88	12,671.16	54,898.50	13,785.55	10,622.00	19,057.94
Preferred stock credits	699.41	123.09	1,072.88	86.15	184.31	1,658.18	2,652.97	
Capital contributions	3,166.84	770.11	3,254.28	2,714.06	5,206.24	30,649.49	4,797.88	73,734.78
Total capital	27,780.74	17,688.02	22,871.39	27,262.40	60,672.80	47,799.47	20,229.29	93,748.64
Total net worth	32,242.34	20,294.04	26,721.51	29,309.55	73,205.11	48,821.68	21,864.82	93,748.64
Total liabilities & capital	57,316.08	34,767.07	51,263.27	64,731.90	93,364.13	74,011.31	47,167.73	118,749.42

Table 19. 1948-49 balance sheet, cooperative gins, Mississippi.

	DELTA					UPLAND		
	All gins	3 stands	4 stands	5 stands	6 stands or more	All gins	4 stands or less	5 stands or more
	34	3	20	6	4	8	5	3
	Average per gin							
ASSETS	$	$	$	$	$	$	$	$
Current assets:								
Cash	12,232.58	12,352.99	6,633.29	26,169.25	19,202.12	24,154.49	10,502.91	46,906.65
Accounts receivable patrons	1,144.23	127.66	585.05	2,916.33	2,298.38	5,183.28	2,365.89	9,878.84
Accounts receivable other	11,582.63	4,042.59	12,707.04	10,905.04	14,516.52	6,106.07	6,290.03	5,799.42
Notes receivable	47.87	----	----	21.28	375.00	7,598.98	8,805.57	5,587.93
Inventory	1,447.64	500.44	1,342.90	1,331.79	3,092.22	16,271.86	----	43,391.21
Total current assets	26,454.95	17,023.68	21,268.28	41,343.69	39,484.24	59,314.68	27,964.40	111,564.05
Fixed assets:								
Cost of fixed assets	48,778.59	35,946.86	40,319.05	55,471.37	93,865.31	52,198.52	33,643.64	83,122.50
Res. for depreciation	15,037.31	11,563.79	11,781.90	17,314.54	31,371.08	25,228.44	16,709.72	39,425.91
Total fixed assets (book value)	33,741.28	24,383.07	28,537.15	38,156.83	62,494.23	26,970.08	16,933.92	43,696.59
Other assets:								
Prepaid expense	758.65	887.54	779.16	459.28	976.25	645.69	726.06	511.72
Organization expense	56.76	100.79	48.87	57.39	51.26	41.96	----	111.90
Stock in other organizations	3,435.21	1,233.16	3,237.33	3,633.29	6,329.34	4,093.57	4,974.56	2,625.20
Investments, gov't bonds, etc.	----	----	----	----	----	2,500.00	----	6,666.61
Total other assets	4,250.62	2,221.49	4,065.36	4,149.96	7,356.85	7,281.22	5,700.62	9,915.43
Total assets	64,446.85	43,628.24	53,870.79	83,650.48	109,335.32	93,565.98	50,598.94	165,176.07

LIABILITIES								
Current Liabilities:								
Accounts payable patrons	16,135.93	11,094.95	13,065.43	29,126.38	17,042.23	25,122.15	24,234.56	26,601.16
Accounts payable others	817.72	1,388.69	544.66	1,264.92	941.26	3,416.76	2,131.28	5,559.19
Notes payable	1,415.29	875.00	1,688.35	1,808.59		187.50		500.00
Accrued expense	763.11	171.04	459.37	1,822.79	1,284.07	701.79	394.68	1,213.65
Total current liabilities	19,132.05	13,529.68	15,757.81	34,022.68	19,267.56	29,428.20	26,760.52	33,874.00
Long term liabilities:								
Mortgage payable	2,655.72	3,525.00	2,129.73	1,599.94	6,000.00	3,883.93	2,600.00	6,023.75
Notes payable	3,886.67	1,500.00	3,753.29	8,512.85				
Total long-term liabilities	6,542.39	5,025.00	5,883.12	10,112.79	6,000.00	3,883.93	2,600.00	6,023.75
Total liabilities	25,674.44	18,554.68	21,640.93	44,135.47	25,267.56	33,312.13	29,360.52	39,897.75
NET WORTH								
Reserves:								
Reserve for future distribution	2,787.00	782.91	2,815.31	1,811.65	6,112.42			
Reserve for contingencies	459.47		455.60	63.57	1,532.18	610.92	977.48	
Reserve for operations	1,218.80	945.00	412.26	1,075.15	5,740.75			
Reserve for replacement	244.52		228.92	622.48				
General reserves	1,077.16	1,297.19	1,364.04		1,038.51	384.43	615.08	
Total reserves	5,786.95	3,025.10	5,276.13	3,572.85	14,423.86	995.35	1,592.56	
Capital:								
Common stock	5,288.11	3,370.00	2,113.85	20,408.18	396.25	1,761.60	2,245.00	955.92
Preferred stock	23,033.94	17,040.00	19,012.00	13,251.14	63,811.00	10,038.35	11,155.00	8,177.19
Preferred stock credits	798.76	100.14	1,271.74	98.29	183.19	1,909.55	3,055.29	
Capital contribution	3,864.65	1,538.32	4,556.14	2,184.55	5,253.46	45,549.00	3,190.57	116,145.21
Total capital	32,985.46	22,048.46	26,935.73	35,942.16	69,643.90	59,258.50	19,645.86	125,278.32
Total net worth	38,772.41	25,073.56	32,229.86	39,515.01	84,067.76	60,253.85	21,238.42	125,278.32
Total liabilities & capital	64,446.85	43,628.24	53,870.79	83,650.48	109,335.32	93,565.98	50,598.94	165,176.07

ceding season. A large proportion of these assets represented investment in equipment and inventories connected with the purchase and sales activities of the gins located within this area. With the large reduction in cotton acreage in the Upland area of this state, prior to World War II. it seems only logical for the gins located in this area to shift to other business activities. At the present time, the volume per gin-stand within this area is too low for efficient operation and the gins remain active more as a service to the patrons of the associations than as a business activity.

Current Assets

Current assets, include cash, accounts and notes receivable, both of patrons and others, and inventories. This item amounted to approximately 40 percent of the total assets held by the associations in the Delta, and approximately 60 percent in the Upland, during both seasons included in this study.

The cash accounts of the various gins were comprised principally of patronage and stock dividends that were received from oil mills too late to be distributed during the current accounting period. Also, patronage and stock dividends had not been paid in full during the current fiscal year.

Accounts receivable, which were made up of advance to patrons, showed an increase in both areas in the season 1948-49 over 1947-48. Although they were not of dangerous proportion, the trend is highly undesirable and should be watched closely by the management of the associations.

Gins in the Upland showed a substantial increase in notes receivable. This may be explained partially by the fact that all of these associations maintained active purchasing associations in conjunction with the gin. This also explains the substantial variations in the inventories held by the gins within the two areas.

Fixed Assets

From 50 to 55 percent of the total assets held by the gins in the Delta at the close of the 1947-48 and 1948-49 seasons were in fixed assets, consisting of land, buildings, machinery, and equipment. Fixed assets accounted for almost 30 percent of the total assets held by the gins in the Upland.

The fact that fixed assets constituted such a large part of the total assets held by the associations located in the Delta is easily explained when one considers that almost three-fourths of these gins were built or completely overhauled within the past ten years and almost one-half were renovated during the high cost war-time period. A large part of the increase investment in fixed assets has been the installation of cleaner extractors, driers and lint flue cleaners.

Other Assets

Other assets, consisting of prepaid expenses, stock in other organizations, and investments, comprised the remainder of the assets held by the gins. In all cases, this account was relatively small.

Liabilities

The item for total liabilities represents the entire indebtness of the associations. Gins in the Delta had total liabilities averaging approximately $25,000 during each of the seasons 1947-48 and 1948-49. At the end of the 1948-49 crop season, this item varied from an average of $18,000 for the 3-stand gins to $44,000 for the gins with 5 stands. The range in the Delta during the 1947-48 season was from an average of $14,000 for 3-stand gins to an average of $35,000 for 5-stand gins.

Average liabilities for all gins in the Upland were $33,000 at the end of the 1948-49 season, an increase of $18,000 over the previous season. During the 1948-49 season the average total liabilities for the smaller gins in the Upland were $29,-

000. This compared to an average of $40,000 for the gins with 5 stands or more and represented an increase over the previous season, when the average total liabilities for both groups were approximately $25,000. Here, again, it should be noted that the gins in the Upland are primarily purchasing associations with the ginning operations constituting a minor portion of the total business operations.

Current Liabilities

Current liabilities, consisting of accounts payable, notes payable, and accrued expenses accounted for approximately three-fourths of the total liabilities of all gins in the Delta. Gins in the Delta held average current liabilities totaling $19,000 at the end of the 1948-49 crop season. These ranged from $13,000 for the 3-stand gins to $34,000 for the gins with 5 stands. It is interesting to note that within this area the smaller and the larger gins held relatively low current liabilities. Current liabilities of the 3-stand and 5-stand gins within the Delta increased between 1947-48 and 1948-49, while an almost equal proportionate decrease occured in this account for the 4- and 6-stand gins. Although total current liabilities were slightly less, or $17,000 for all gins in this area during 1947-48, the same relationship among the groups of gins existed.

At the close of the 1948-49 crop season, the average gin within the Upland area held current liabilities totaling $29,000. This was approximately 80 percent of the total liabilities. The average ranged from $26,000 for the gins with 4 stands or less to $33,000 for those gins with 5 stands or more within this area. This represented an increase over the 1947-48 season of approximately 20 percent for the small gins and of almost 50 precent for the large gins.

Accounts payable, the major portion of the total current liabilities accounts, were patronage refunds that had not been distributed to the members. Although the associations had approximately a 1 to 1 relationship between current assets and current liabilities, the situation was not as bad as it may appear since the owners of the associations were the holders of the major portion of the current liabilities.

Long-Term Liabilities

Long-term liabilities, consisting of accounts such as mortgages payable and notes payable constituted the remaining one-fourth of the total liabilities of the gins in the Delta. The average size of this acount for these gins was almost $7,000 at the close of the 1948-49 season, and slightly over $7,000 for the previous season. In no case did the long-term liabilities constitute more than 30 percent of the total liabilities during the 1948-49 season, or more than 35 percent during the 1947-48 season. This shows a favorable trend in view of the fact that approximately 75 percent of the association gins were built new or completely renovated since 1941. The relatively sound position occupied by the associations at the present time may be attributed to the fact that for the past few years the gin operators have been experiencing a period of prosperity. The price of cottonseed, the major of source of savings to the associations, has been on a continuous incline for the past few years. The peak in the price of seed was in the latter part of the 1947-48 harvest season, but because of increased volume in 1948-49, the total savings that year were larger than in the previous year.

At the close of the 1948-49 season the average Upland gin had long-term liabilities amounting to about $4,000, a decrease of approximately $1,000 from the 1947-48 season. These figures ranged from an average of about $3,000 for the small gins to $6,000 for the large gins, for the 1948-49 season, and varied from an average of about $3,000 to slightly over $7,000 during the previous season. All of this was held in the form of mortgages payable.

Members' Equity

Membership equity is represented by the ratio between total assets and the net worth accounts of the patrons, reserves, and capital stock. The relationship between patron's equity and total assets is a good indication of the interest and support given to the associations by those who use them.

At the close of the 1947-48 crop season, in approximately 35 percent of the associations in the Delta, patron's equities were equal to less than 40 percent of their total assets. In approximately 15 percent of the associations equities equaled less than 55 percent, and in another 35 percent less than 70 percent. The remaining 15 percent had equities equal to over 70 percent of the total assets controlled by the associations (table 20).

In the same year the patrons in one of the eight associations located in the Upland had equities equal to less than 40 percent of their total assets. The patrons of 3 of the associations had equities equal to less than 55 percent of the total assets. Patrons of 2 of the associations had equities of from 55 to 70 percent, while patrons of 2 of the associations had equities of more than 70 percent.

This picture changed considerable by the close of the following season, when only 15 percent of the Delta associations remained in the group with less than 40.0 percent, or a decrease of 18 percent from the 1947-48 season. Twenty-seven percent of the associations fell within the 40 to 55 percent bracket, an increase of 12 percent over the preceding year. The same proportion of associations in both years was found in the group that had equities equal to 55 to 70 percent of their total assets. In 27 percent of the associations, at the end of the season, patrons had equities equal to over 70 percent of their total assets, an increase of 12 percent over the preceding year.

In the Upland, only two associations shifted position. In one association, the members' equity fell to less than 40 percent, and one of the associations moved up to 70 percent and over. In the main, the percentage of total patrons' equities increased in the latter period. This movement was due primarily to the fact that

Table 20. Number of cooperative gins of indicated size having indicated equities in total assets, Mississippi, 1947-48 and 1948-49 seasons.

	Percentage of patron's equity							
	0-39.9		40.0-54.9		55.0-69.9		70.0-over	
Size of gin	1947	1948	1947	1948	1947	1948	1947	1948
Delta								
No of Stands:			Number of gins					
3	1	2	..	..	2	1		1
4	6	1	5	7	6	6	3	6
5	4	2	..	2	1	2	1	..
6 or over	..	..	..	..	2	2	2	2
Total	11	5	5	9	11	11	6	9
Upland								
No of Stands:								
4 or less	1	2	2	2	1	1	1	..
5 or more	..	..	..	..	1	..	1	2
Total	1	2	3	3	2	1	2	2

a very large cotton crop was harvested during the 1948-49 season, weather conditions were excellent, and prices of seed remained relatively high. The primary factors were the substantial increase in volume per gin stand with lower ginning cost per bale resulting and the increase in volume of cottonseed handled.

Income And Cost Of Operation

Sources of Income

Associations located in the Delta obtain the major portion of their income from ginning operations, including revenue from sale of bagging and ties and the purchase and sale of seed. Associations located in the Upland have purchasing activities, in addition to the above sources, that are operated in conjunction with the gins.

Gross Revenue From Gins

Revenue from gins accounted for 69 percent of the average total gross income of all gins in the Delta during the 1948-49 season. The average income from this source for all gins was approximately $36,000, and varied from about $26,000 for the average 3-stand gin to about $63,000 for the gins with 6 or more stands. This was an average increase for these two groups of approximately 100 percent over the previous season (tables 21 and 22). This increase may be explained by the fact that the volume per gin within the area increased in approximately the same proportion, and that charges for ginning were also increased. It may be noted however, that the average revenue from gins for all groups in the Delta made up only about 53 percent of average total gross revenue during the 1947-48 season, reflecting the extremely high income from seed during 1947-48 as compared to the following season.

In 1948-49 the average total gross revenue from gins for all groups in the Upland was about $16,000, or about 65 percent of the total. In the previous season revenue from gins, averaging about $8,000, accounted for about 60 percent of the total.

There was only a slightly higher average gross revenue for the group of large gins than for the small gins for the 1948-49 season. The relationship between the two seasons was approximately the same as that which existed within the Delta.

Gross Revenue From Seed

In the 1948-49 season the average total revenue from seed for all gins in the Delta was about $16,000, while in the Upland, it was slightly under $9,000. In the previous season income from this source averaged about $18,000 in the Delta and about $6,000 in the Upland.

The revenue obtained from this source, by the several associations, presented a decidedly different picture than did the revenue from the ginning operations. Even with the unusually large increase in volume per gin from 1947-48 to 1948-49, the average revenue from cottonseed increased 50 percent in the Upland and decreased about 10 percent in the Delta. In the latter area the decrease in revenue from this source was appproximately 20 percent. This decrease in income may be explained by the fact that during the 1947-48 season, when the volume of cottonseed available was quite low, the price of cottonseed was extremely high. In the following season, with a much larger volume, the price of cottonseed declined steadily and, at the close of the season, the average price was approximately 50 percent below the average received by the associations the previous season. Consequently, a decline in revenue from this

Table 21. Average revenue from various operations, cooperative gins, State of Mississippi, 1947.48 season.

Size of gin	No. of gins	Av. total bale	Av. gross revenue from gin[1]		Av. gross revenue from seed[2]		Av. total gross revenue		Av. total expenses[3]		Av. net revenue from gin and seed		Av. net purchases[4] revenue from		Av. total net revenue	
			Per gin	Per bale	Per gin	Per bale	Per gin	Per bale	Per gin	Per bale	Per gin	Per bale	Per gin	Per bale	Per gin	Per bale
							Delta									
3 stands	3	1628	11602.78	7.13	9990.61	6.13	21593.39	13.26	8400.43	5.16	13192.96	8.10	....	....	13192.96	8.10
4 stands	20	2666	19089.30	7.16	14619.48	5.48	33708.78	12.64	14774.24	5.54	18934.54	7.10	....	....	18934.54	7.82
5 stands	6	2749	21042.91	7.66	17953.70	6.53	38996.61	14.19	17627.08	6.41	21369.53	7.78	....	....	21369.51	7.78
6 stands or more	4	4781	32866.52	6.87	38449.52	8.04	71316.04	14.91	27625.37	5.78	43690.67	9.13	....	....	43690.67	9.13
Average all Delta gins	33	2843	20433.93	7.19	17693.38	6.22	38127.31	13.41	16271.21	5.72	21856.10	7.69	....	....	21856.10	7.69
Upland																
4 stands or less	5	1612	9117.42	5.66	7253.12	4.50	16370.54	10.16	14094.25	8.75	2276.29	1.41	9906.65	6.15	12182.94	7.56
5 stands or more	3	1637	7688.38	4.70	4169.85	2.55	11858.23	7.25	12185.94	7.45	—327.71	—.20	27559.06	16.84	27231.35	16.64
Average all Upland gins	8	1621	8581.54	5.29	6096.89	3.76	14678.43	9.05	13378.63	8.25	1299.80	.80	16526.30	10.20	17826.10	11.00

[1] Includes returns from ginning plus the difference in the sales and purchases of bagging and ties.

[2] Difference in the sales and purchases of seed adjusted for gains or losses in weight of seed and transportation of seed.

[3] Includes both operating and non-operating expenses.

[4] Net Purchase Revenue is the net gains from purchasing activities in conjunction with gins in Upland area.

source was experienced by all gins in the Delta except those in the 5-stand group. This resulted when several of the gin managers in the other size group withheld seed in hopes of a raise in price during the latter part of the harvest season. This is an outstanding example of the danger involved when a cooperative, or any other organization of this type, attempts to speculate with the products of the members.

Net Revenue From Gins

Net revenue from the gins, consisting of the combined net revenue from both ginning operations and seed operations, averaged approximately $26,000 for gins in the Delta for the 1948-49 season, with the variation from slightly over $17,000 for the 3-stand gins to approximately $48,000 for the gins with 6 stands or more. During the previous season the average was approximately $22,000, and the variation from slightly over $13,000 for gins with 3 stands to approximately $44,000 for gins with 6 stands or more.

In the Upland, during the 1948-49 season, the average net revenue from this source for all gins was approximately $7,000, compared with slightly over $1,000 in the previous season. This sharp increase in revenue may be explained by the fact that the volume per gin-stand increased by approximately 100 percent for the low-volume groups. This enabled the gins within these groups to utilize their resources much more efficiently.

Net Revenue From Purchasing Activities

The operation of purchasing agencies was confined entirely to the Upland. This was due primarily to the fact that the shift away from cotton production before and during World War II had reduced the supply of cotton so much that efficient operation of gins alone was difficult. The gins within this area had to enter other fields or close down completely. This resulted in many associations turning to purchasing activities. The income from this source in the 1948-49 season averaged about $10,000 for the gins with 4 stands or less, and over $40,000 for the gins with 5 or more stands (table 21). This represented over three-fourths of the total income of these associations. In previous seasons, income from purchasing operations of the small gins accounted for about 80 percent of the total. For the larger group a proportion of the income from this source was used to compensate for losses incurred from the ginning operation and, as a result, income from purchasing activities actually exceeded the total net revenue.

Cost Items of Ginning

The expense incurred for labor, fuel, depreciation, repairs, and insurance made up approximately 85 percent of the total cost of ginning for gins in the Delta during the 1947-48 and 1948-49 seasons. The remaining items of cost were taxes, interest, bank charges audit fees, handling, and other miscellaneous expenses.

Labor, the major item of cost, accounted for 37 percent of the cost per bale of ginning in the Delta during both the 1947-48 and the 1948-49 seasons. Fuel costs per bale increased from 12 to 16 percent of the total.

This was also true of repairs which showed an increase from 10 percent of the total cost per bale during the 1947-48 season to 12 percent during the following season. Because of increased volume for the 1948-49 season depreciation dropped from 15 to 12 percent and insurance from 10 to 8 percent over the 1947-48 season (tables 23-24).

The same general relationship between these five cost items existed in the Upland. They made up approximately 75 percent of the total cost of ginning in this area in 1948-49 and 73 percent in 1947-48. A major difference in these items between areas was that the cost of de-

Table 22. Average revenue from various operations, cooperative gins, State of Mississippi, 1948-49 season.

Size of gin	No. of gins	Av. total bales	Av. gross revenue from gin[1]		Av. gross revenue from seed[2]		Av. total gross revenue		Av. total expenses[3]		Av. net revenue from gin and seed		Av. net revenue from purchases[4]		Av. total net revenue	
			Per gin	Per bale	Per gin	Per bale	Per gin	Per bale	Per gin	Per bale	Per gin	Per bale	Per gin	Per bale	Per gin	Per bale
							Dollars									
3 stands	4	3005	25822.86	8.59	8246.58	2.75	34069.44	11.34	16593.47	5.52	17475.97	5.82	....	....	17475.97	5.82
4 stands	20	3992	31099.79	7.79	12562.11	3.15	43661.90	10.90	21973.86	5.50	21688.04	5.44	....	....	21688.04	5.44
5 stands	6	4909	39009.39	7.95	21089.10	4.29	60098.40	12.24	29035.65	5.91	31062.84	6.33	....	....	31062.84	6.33
6 stands or more	4	6848	63061.62	9.21	31596.19	4.61	94657.81	13.82	46232.16	6.75	48425.65	7.07	....	....	48425.65	7.07
Average all Delta gins	34	4374	35635.00	8.15	15798.47	3.61	51433.47	11.76	25440.99	5.82	25992.48	5.94	....	....	25992.48	5.94
Upland																
4 stands or less	5	2613	15559.44	5.95	8589.15	3.29	24148.59	9.24	18827.86	7.20	5320.73	2.04	10140.21	3.88	15460.94	5.92
5 stands or more	3	3008	16104.88	5.35	8622.00	2.87	24726.88	8.22	15678.49	5.21	9048.39	3.01	40808.37	13.56	49856.76	16.57
Average all Upland gins	8	2761	15763.98	5.71	8601.47	3.11	24365.45	8.82	17646.84	6.39	6718.61	2.43	21640.77	7.84	28359.38	10.27

[1] Includes returns from ginning plus the difference in the sales and purchases of bagging and ties.

[2] Difference in the sales and purchases of seed adjusted for gains or losses in weight of seed and transportation of seed.

[3] Includes both operating and non-operating expenses.

[4] Net Purchase Revenue is the net gains from purchasing activities in conjunction with gins in Upland area.

preciation per bale was higher and accounted for a larger proportion of total costs in the Upland than in the Delta because of the lower volume of cotton ginned.

When the cost of hauling was added to the five major cost items already enumerated, the proportion of total expenses would have been increased to about 85 percent of the total cost of ginning in the Upland. This cost in the case of the small gins was made up of expenses in transporting cottonseed. These gins did not have enough seed volume to pay the oil mills to which they sold to finance the hauling expenses as did the larger gins where the volume of seed was large. In other words, the small gins in the Upland were at a disadvantage when selling their seed due to small volume.

It is in this group of cost items that the greatest economies of operation may be affected. Every effort should be made to utilize the labor force and the fuel supply fully and efficiently and take the necessary precautions to prevent damage to gin machinery. Good management and adequately trained labor have become more and more important with the increase in gin investment, the increase of mechanical harvesting, and the high premium now placed on the grade factor in cotton quality.

Relation of Volume to Cost of Ginning

Volume was one of the major factors in determining the cost per bale of operating a cotton gin. The average cost per bale for gins in the Delta in 1948-49 varied from $5.20, for those gins with a volume ranging from 950 to 1,049 bales per gin stand, to $6.82, for those gins with a volume of less than 850 bales per gin stand. One group of gins in this area had a volume of over 1,050 bales per gin stand with a cost per bale of $5.68, an average of 48 cents higher than the group ginning from 950 to 1,050 bales per stand. This means that during the 1948-49 season, the additional volume was ginned at increasing costs per bale and that the optimum volume for this season fell between 950 and 1,050 bales per gin stand. The average cost for all gins in the Delta during this period was $5.82 per bale (table 24).

During the previous season, the cost per bale for gins within the Delta ranged from $5.21 for the gins with the volume of 750 bales and over per stand to $7.41, for those gins with a volume of less than 500 bales per stand (table 23). During the season, no gin in this area reached a volume large enough to determine accurately the optimum volume.

The range in total cost between volume groups was considerably greater in 1947-48 than 1948-49. Also, the volume per gin stand was only 65 percent as great. But the average cost per bale for all gins in the Delta was $5.72 in 1947-48 compared to $5.82 for the season for 1948-49, or 10 cents per bale lower in the former season. This lower cost per bale was due largely to a considerable lower price for fuel, labor, and repairs. These three cost items combined made up approximately 65 percent of the total cost of ginning a bale of cotton in 1948-49, compared with approximately 59 percent of the total cost in the previous season.

The average fuel cost for gins in the Delta increased from 66 cents per bale in 1947-48 to 92 cents in 1948-49. This is an increase of 26 cents per bale. This marked increase was due to the higher prices for fuel and to the extremely wet harvest season in 1948 compared to a rather ideal harvest season in 1947. This necessitated the use of driers for a large part of the ginning season which resulted in the consumption of a greater amount of fuel. Gin managers estimated, at the time of interview, that the fuel consumed in the operation of driers cost 25 to 30 cents per bale. The second factor that may be associated with an increase in the consump-

Table 23. Effect of volume on cost of ginning cotton, cooperative gins, Mississippi, 1947-47 season.

Gins grouped by volume per gin stand	No. of gins	Av. total bales per gin	Av. bales per gin stand	Fuel	Labor	Repairs	Hauling	Interest and bank charges	Insurance	Taxes	Depreciation	Other expenses	Total expenses	Gross revenue gin	Net revenue gin	Net revenue purchasing	Total net revenue
								Average dollars per bale									
Delta																	
300-499 bales	5	1733	413	.71	2.54	.90	.23	.14	.56	.14	1.22	.97	7.41	13.41	6.00	....	6.00
450-599 bales	12	2535	516	.69	2.28	.44	.12	.16	.54	.17	1.03	.53	5.96	13.17	7.21	....	7.21
600-749 bales	7	2777	670	.74	1.88	.62	.07	.08	.61	.11	.92	.51	5.54	14.20	8.66	....	8.66
750 bales & over	9	3923	861	.59	1.93	.52	.24	.19	.53	.13	.54	.54	5.21	13.18	7.97	....	7.97
Total Delta	33	2843	626	.66	2.09	.55	.16	.15	.55	.14	.84	.58	5.72	13.41	7.69	....	7.69
Upland																	
399 bales or less	5	1389	248	.71	3.25	.66	1.24	.23	.66	.91	1.95	.82	10.43	7.76	—2.67	18.36	15.69
400 bales & over	3	2008	502	.35	2.03	.62	.09	.07	.36	.25	1.25	.72	5.74	10.54	4.80	.78	5.58
Total Upland	8	1621	324	.54	2.69	.64	.71	.16	.52	.60	1.62	.77	8.25	9.05	.80	10.20	11.00

Table 24. Effect of volume on cost of ginning cotton, cooperative gins, Mississippi, 1948-49 season.

Gins grouped by volume per gin stand	No. of gins	Av. total bales per gin	Av. bales per gin stand	Fuel	Labor	Repairs	Hauling	Interest and bank charges	Insurance	Taxes	Depreciation	Other expenses	Total expenses	Gross revenue gin	Net revenue gin	Net revenue purchasing	Total net revenue
								Average dollars per bale									
Delta																	
894 bales or less	8	3263	705	.97	2.70	.84	.15	.06	.66	.13	.76	.55	6.82	12.25	5.43	....	5.43
850-949 bales	9	4397	920	.91	2.03	.81	.16	.02	.46	.13	.77	.44	5.73	13.42	7.69	....	7.69
950-1049 bales	6	4026	1006	.78	1.91	.63	.11	.06	.44	.08	.65	.54	5.20	10.31	5.11	....	5.11
1050 bales & over	11	5353	1203	.96	2.17	.62	.18	.13	.42	.10	.60	.50	5.68	11.05	5.37	....	5.37
Total Delta	34	4374	972	.92	2.18	.71	.16	.07	.48	.10	.68	.52	5.82	11.76	5.94	....	5.94
Upland																	
499 bales or less	4	2655	425	.59	2.31	.91	.92	.16	.35	.54	1.21	.74	7.73	8.44	.71	15.83	16.54
500 bales & over	4	2868	765	.37	2.15	.48	.11	.04	.25	.18	.97	.60	5.15	9.18	4.03	.44	4.47
Total Upland	8	2761	552	.48	2.23	.68	.50	.09	.30	.36	1.08	.67	6.39	8.82	2.43	7.84	10.27

tion of fuel was a rather marked increase in mechanically-harvested cotton. Cotton harvested by this method has a tendency to "rope" and become imbedded in the gin saws, resulting in many stoppages to free the saw teeth. This decreases the number of bales that may be processed in a given period of time, resulting in less efficient use of fuel and also increasing the total cost per bale of ginning.

The average cost per bale for labor for gins in the Delta for the 1948-49 season was $2.18 as compared to $2.09 during the previous season, an average increase of 9 cents per bale. This increase may be attributed to a reduced number of bales ginned per hour due to adverse weather conditions during the harvest season, which resulted in a higher proportion of wet and immature cotton; to the use of double shifts of labor; and to an increase in the price level of labor. The second shift of labor employed was not utilized as efficiently as the regular crew because of lower ginning volume per hour during the night and early morning.

A third major cost item, repairs, increased from an average of 55 cents per bale, for all gins in the Delta during the 1947-48 crop season to an average of 71 cents per bale for the 1948-49 crop season. This constituted an increase of 16 cents per bale. This increase may be attributed to increased breakdowns resulting from ginning wet-harvested and mechanically-harvested cotton, and to the increased availability of building materials and other supplies that were badly needed to repair buildings and equipment that had been allowed to deteriorate during the war and immediate post-war period.

The average cost in 1947-48 for ginning in the Upland was $10.43 per bale for gins with a volume of less than 400 bales per gin stand. In comparison, gins with a volume of 400 bales and over had an average cost of $5.74, or a difference of $4.69 (table 23). In 1948-49, comparable cost figures were $7.73 and $5.15, respectively (table 24). During the 1947-48 season, the average total cost for all gins in the Upland was $8.25. It was $6.39 in the 1948-49 season. This is an over-all decrease of $1.86 per bale. The rather high cost in the 1947-48 season may be explained by the fact that 5 of the 8 gins included within this area had a volume of less than 400 bales per stand, three gins out of these five had less than 300 bales per stand. This exceptionally low volume resulted in the gin operating only part of the time, although it was necessary to stand ready to operate all season. When this is considered, it is rather obvious that total cost per bale would be extremely high.

The decided decline in the major cost items per bale in the Upland in the 1948-49 season, for those gins in the low volume group, may be explained by the fact that the volume per gin stand increased over 1947-48 by approximately 100 percent. During 1948-49, the gins in the larger volume group enjoyed a volume considerably higher than they did in the previous season, and therefore, were able to utilize their labor, fuel, and other resources more efficiently.

A general over-all statement may be constructed in summarizing the volume-cost relationship. The average volume per gin stand was a large determinate of the cost of ginning per bale during each season. Until the optimum volume per gin stand was reached, all costs per bale showed a tendency to decrease with increasing volume. Because of the nature of fixed costs, depreciation and insurance showed decreases after the optimum volume in terms of total cost had been reached. The weather conditions and general price relationships, as well as volume per gin stand, are the major determinates when comparing two or more seasons.

Allocation of Net Revenue

The total net savings of the associations were allocated to capital stock dividends, and to the patrons.

Table 25 Allocation of net revenue prior to patron's refund, cooperative gins, Mississippi, 1947-48

Size of gin	Dividend on stock			Available for patron's refund		Total net revenue	
	No. of gins	Average per gin, dollars	Percent	Average per gin, dollars	Percent	Average per gin, dollars	Percent
Delta							
3 stands	3	1,088.77	8.3	12,104.19	91.7	13,192.96	100.0
4 stands	20	1,271.03	6.7	17,663.51	93.3	18,934.54	100.0
5 stands	6	1,563.92	7.3	19,805.59	92.7	21,369.51	100.0
6 stands and over	4	2,740.31	6.3	40,950.36	93.7	43,690.67	100.0
Total or average	33	1,485.86	6.8	20,370.24	93.2	21,856.10	100.0
Upland							
4 stands or less	5	516.30	4.2	11,666.64	95.8	12,182.94	100.0
5 stands or over	3	978.26	3.6	26,253.09	96.4	27,231.35	100.0
Total or average	8	689.54	3.9	17,136.56	96.1	17,826.10	100.0

At the close of the 1948-49 season, the average total net revenue for all associations in the Delta was approximately $26,000. Approximately 7 percent of this figure was allocated to capital stock dividends, and the remaining 93 percent was made available for patronage refunds. During the previous season, the average total net revenue of $22,000 was allocated in approximately the same proportion (tables 25 and 26).

The average total net revenue for gins in the Upland for the season 1948-49 was slightly over $28,000. Of this total, approximately 2 percent was allocated to capital stock dividends, and 98 percent was made available for patronage refunds. During the previous season, when the average total net revenue was $18,000, the allocation to capital stock was approximately 4 percent. This figure tended to vary indirectly with the net savings of the associations, due to the fact that the amount of stock outstanding remained relatively stable.

Allocation of Patronage Refunds

That amount of the total net revenue of the association that was made available for patronage refunds was allocated to patrons in the form of cash payments, reserves, book credits, capital stock, and credits for money owed the association by the patrons.

At the close of the 1948-49 season, the average total savings made available for patronage refunds was slightly over $24,000 for the Delta. Approximately 73 per-

Table 26. Allocation of net revenue prior to patron's refund, cooperative gins, Mississippi, 1948-49.

Size of gin	Capital stock dividend			Available for patron's refund		Total net reveune	
	No. of gins	Average per gin, dollars	Percent	Average per gin, dollars	Percent	Average per gin, dollars	Percent
Delta							
3 stands	4	1,017.02	5.8	16,548.95	94.2	17,475.97	100.0
4 stands	20	1,373.42	6.3	20,314.62	93.7	21,688.04	100.0
5 stands	6	2,039.56	6.6	29,023.28	93.4	31,062.84	100.0
6 stands or more	4	3,675.39	7.6	44,750.26	92.4	48,425.65	100.0
Total or average	34	1,719.87	6.6	24,272.61	93.4	25,992.48	100.0
Upland							
4 stands or less	5	534.52	3.5	14,926.42	96.5	15,460.94	100.0
5 stands or more	3	352.34	.7	49,504.42	99.3	49,856.76	100.0
Total or average	8	466.21	1.6	27,893.17	98.4	28,359.38	100.0

cent of this total was paid patrons of the associations in the form of cash, and slightly over 3 percent was allocated to the patrons' accounts and held by the associations in the form of reserves. Approximately 10 percent was carried on the books of the associations as book credits or capital contributions. An additional 10 percent of the refund was paid in the form of stock, and the remaining 4 percent was applied to receivable accounts against the patrons (tables 27 and 28).

During the 1947-48 season for the Delta the total patrons' refund available for allocation was slightly over $20,000 per gin. Approximately 70 percent was paid to the patrons in cash, almost 5 percent was allocated to reserves, and slightly over 5 percent was carried on the association's books as capital contributions. Approximately 15 percent of the total refund was paid in the form of stock and the remaining 5 percent was credited to the receivable accounts held by the association against the patron.

At the close of the 1948-49 season, the average total refund for all gins in the Upland was approximately $28,000. Only 41 percent was paid to the patrons in cash. Slightly over 6 percent was allocated as reserve, and almost 51 percent of the total refund was allocated as capital contributions. The remaining 2 percent of the total net refund was paid in stock.

During 1947-48, the average patronage refund available in the Upland area was slightly over $17,000. The proportional distribution of this refund to the various accounts was approximately the same as that for 1948-49. The major difference in allocation between seasons was that reserves, as a percentage of the total refund, were decreased by approximately 3 percent and stock issued, as a portion of total patronage refund, increased by 2 percent. During 1947-48 the proportion of total refund that was allocated in cash was slightly over 42 percent, or one percent larger than that during the 1948-49 season.

The capital contribution method of capital accumulation gives rise to gross inequities within the association unless those patrons who own the capital that is carried as capital contributions, or as book credits, patronize the association each year in the same proportion as those that have capital invested. Another evil that is associated with this type of capital formation is that in the absence of a revolving plan, those persons who own capital in the form of capital contributions may conceivably never be repaid.

Summary And Conclusions

Organization and Operation

All of the 42 gins included in this study, 34 in the Delta and 8 in the Upland, were organized by cotton producers as capital stock associations. Preferred stock was the major class of stock at the time of organization and continued to be the major type issued after beginning operation. In most cases dividends of 6 to 8 percent have been paid on this class of stock.

Most gins have issued only small quantities of common stock and have used this type of stock mainly as a membership requirement and not to raise capital. These shares have had considerably lower par value than preferred stock. Few associations pay stock dividends on common stock.

One of the shortcomings of the organization and operation of cooperative gins has been the failure to make provision for the retirement of stock owned by non-participating members. This raises problems of control of the associations' affairs as well as for the non-participating members who might have difficulty in obtaining money for this evidence of ownership, particularly during depression periods in the ginning industry.

The associations generally follow the 'one man, one vote' principal, although in frequent instances, members vote each share of capital stock owned by them.

The requirement for membership set up by the cooperative gins was very liberal. Members had to buy one share of capital stock, usually common, and be cotton producers. No discrimination as to size of farm operation or race was evident, although producers had to be able to show title to their cotton.

Delta cooperative gins usually had small numbers of members. Over 70 percent had less than 30 members. Upland associations had large memberships, in all cases over 170 members. In both areas, approximately 80 percent of the associations had three-fourths or more of their members as patrons.

The Delta associations had a larger proportions of their members at annual meetings than did the Upland cooperative gins. Greater emphasis should be placed by the management of the associations in both areas on attendance at these meetings.

The board of directors assumed the function of policy-making as far as business management was concerned. The board or some of its members made more of the day-to-day business decisions in the Delta than in the Upland area. Those who hired full-time managers in the Delta usually hired men with experience in the field of gin operation. The highly seasonal type of operation in the Delta and the smaller membership was the primary cause of this type of management.

Most of these associations gin cotton for or sell farm supplies to non-member producers. These producers were treated the same as members in payment of patronage dividends and were issued preferred stock or given book credit to show contribution to the capital of the association. They were given no voting rights.

Marketing Practices

All cooperative gins made a flat ginning charges for all hand-picked cotton. In the Delta, gins were beginning to make additional charges for ginning snapped or mechanically-harvested cotton. During the 1948-49 season, gin charges ranged from 25 to 75 cents per hundred weight of seed cotton in the Delta and from 25 cents to 55 cents in the Upland.

A separate charge was levied for bagging and ties by all of the associations in the Delta, and by all except one in the Upland. The average charges made for bagging and ties varied from $3.00 to $3.50 in both the Delta and Upland. There was a tendency to increase the charges over the two-year period.

All of the associations in this study purchased the cottonseed from the patrons as the cotton was ginned. Only 8 of the associations had mechanical seed scales. The remaining 34 associations used a dockage formula to derive the weight of the seed. The majority of the associations based their purchase price of seed on oil mill quotations, and sold on the basis of grade and moisture content. The majority of the associations used cooperative and commerical oil mills as outlets for their seed. Approximately 60 percent of the associations negotiated price either before or after obtaining the seed. This is a speculative venture and should be discouraged. The remaining 10 percent of the associations operated on a fixed spread of 3 to 5 dollars per ton of seed.

Only 8 of the associations, all located in the Upland, operated active purchasing associations. This expansion in services resulted from the drastic reduction in volume per gin stand received by the gins in this area. This reduction was primarily a result of the shift from cotton production during World War II to a more diversified system of farming. The 3 major products handled by these associations were cottonseed meal, cottonseed hull, and fertilizer. Two of the associations also operated feed mills. The successful operation of the purchasing associations has enabled the gins located in this area to continue their operations without increasing the charge for ginning.

Financial Status

Capital investment necessary for the operation of cooperative gins has become greater with the advent of new cleaning and drying equipment, and the necessity of installing this equipment during the high-cost period. High costs have also been incurred in the renovation of various gin buildings. By the end of the 1948-49 season the average Delta gin had total assests of over $64,000. The average Upland association had total assests of over $93,000, most of which was accounted for by their purchasing agencies rather than by gin operation.

Most of the associations were making rapid strides toward the retirement of their liabilities at the end of the 1948-49 season. Sixty percent of the associations in the Delta had members equities to 55 percent or more of the total assets. At the end of this same season, 38 percent of the associations in the Upland had member equities of 55 percent or more of their total assets. All gin associations should make every effort to retire as much of their indebtedness as possible during the present high price period. These debts, incurred at peak prices, will be hard to pay during depression periods in agriculture.

Source of Income and Cost of Operation

The associations located in the Delta obtain the major portion of their income from ginning operations, including the revenue from sale of bagging and ties, ginning charges, and the purchase and sale of seed. Associations located within the Upland obtain a large part of their income from the operation of purchasing associations, in addition to the above sources.

Revenue from the ginning operation alone accounted for almost 70 percent of the total gross income in the Delta, and about 65 percent in the Upland, during the 1948-49 season. Revenue from the purchase and sale of cottonseed, the second major source of revenue, amounted to approximately 30 percent of the total gross revenue in the Delta and slightly over 35 percent of the total gross revenue in the Upland. Even with an increase of approximately 60 percent in volume in 1948-49, the revenue from this source fell in the Delta and rose only slightly in the Upland. This was due primarily to a fall in the price received for cottonseed during the 1948-49 season and to speculative operations in negotiating price by the associations.

The average net revenue from the gin, consisting of the combined revenue from both ginning and seed operations amounted to approximately $26,000 in the Delta and approximately $7,000 in the Upland in 1947-48.

The net revenue from purchasing activities, which were confined entirely to the Upland, constituted over three-fourths of the total net income to these associations.

Labor, fuel, depreciation, repairs, and insurance were the major cost items incurred in the operation of the gins. These five items constituted approximately 85 percent of the total cost of ginning in the Delta and almost 75 percent of total cost in the Upland. Labor and fuel accounted for the greater part of the total cost. Every effort should be made to utilize the labor force and the fuel supply fully. Good management has become more and more important with the increase in gin investment.

There was evidence of an indirect relationship between volume per gin stand and cost per bale of ginning. As volume increased, cost per bale declined in both areas until the optimum was reached at a volume range between 950 to 1,049 bales in the Delta during the 1948-49 season. In neither season did volume in the Upland reach a point where optimum volume in terms of minimum cost of ginning could be determined. It was evident that weather conditions and general price relationships as well as volume per gin stand were the major cost determinates when comparing two or more seasons.

The total net savings of the associations were allocated to capital stock dividend and to the patrons. In the Delta at the close of the 1948-49 season, approximately 7 percent of the total net saving was allocated to stock dividend. In the Upland, only slightly less than 2 percent of the total net saving was allocated to this account. The remainder in both areas was allocated to the patrons in the form of cash payments, reserves, capital contributions, stock issuance, and applied to receivables. Approximately 73 percent of the total patron's refund was paid in cash by the associations located in the Delta and about 41 percent by those in the Upland, at the close of the 1948-49 season.

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SUPPLY AND USE OF MILK AND CREAM

Purchased From Producers By Mississippi Dairy Manufacturing Plants

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
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SUPPLY AND USE OF MILK AND CREAM

Purchased From Producers

By Mississippi Dairy Manufacturing Plants

By B. K. DOYLE [1]

Introduction

Dairy manufacturing plants are the most important market outlets for milk produced in Mississippi. Condenseries, cheese plants, creameries, and ice cream plants receive more than one-half of 'all milk sold from farms in this state.

This study analyzes the seasonal milk supply and use situation in dairy manufacturing plants in Mississippi. An attempt was made to determine certain changes that have taken place from 1939 to 1948, and the direction in which these changes were moving. It is hoped that this study will point up some of the short- and long-time supply problems. This will give production and marketing workers a basis for planning further research and programs for developing the milk supply. Out of this should come ways for dairy manufacturing plants to make more efficient use of their resources, and for dairy producers to realize maximum returns for their products.

Objectives

Briefly stated, the main objectives of this study are as follows: (1) to determine the amount of milk being used by various types of dairy manufacturing plants in Mississippi, (2) to determine specific uses made of butterfat and skim portion of producer supplies received by these plants, (3) to determine seasonality in supplies and utilization by types of plants studied, (4) to determine the number and location of manufacturing plants in Mississippi in relation to supplies, (5) to study seasonality in prices paid for producer supplies by manufacturing plants, and (6) to point out trends in the industry as indicated by information available.

Seasonality Of Milk Supplies

The great variation in milk supplies from month to month and season to season is brought about because of the natural tendency for cows to freshen in the spring, the availability of pastures during spring and summer seasons, and the effect of climate in general on milk production. Because of these natural factors, milk production reaches a peak during the period May through July, and a low point from November through January.

Fluctuation in supply causes inefficiencies in the handling of milk from the producer through the processing plant. Enough equipment and labor must be available for the handling of peak loads. Increased costs are incurred because of the use of these resources at much less than capacity over much of the year. In some instances cooling stations are maintained by plants. They must also be able to handle peak loads and are used at near capacity only a few months during the flush production period.

Fixed charges such as building and equipment upkeep, management, depreciation, and interest on investment must be paid regardless of what extent of capacity plants operate. Although no attempt has been made to determine the extent of capacity dairy manufacturing plants are operating at the present time, undoubtedly they are operating at below capacity even during the spring and summer months. A study made by the Mississippi Experiment Station in 1944 indicates that these manufacturing plants operate at less than three-fourths of capacity during the peak production month. "The summarization of these data show that these plants operate at about two-thirds of capacity during their peak month, at slightly less than one-fourth of capacity during the month in which their volume was lowest, and averaged operating at 45 percent of capacity for the year."[2] This situation makes impossible the full utilization of plant resources. Although a stable level of production is not as necessary for dairy manufacturing plants as for fluid milk plants, because the former produces a storable product, the nearer to capacity these plants operate throughout the year, the lower will be their cost of operation per unit of product handled.

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[1] The author would like to express his appreciation to the dairy plant managers and supervisors whose cooperation made this study possible. Special assistance was also given by the Mississippi Department of Agriculture and Commerce; the Office of the Agricultural Statistician, Bureau of Agricultural Economics, USDA, and the Dairy Department, Mississippi State College.

Source Of Data

The data in this study were obtained from personal interviews with dairy plant managers and from annual reports of dairy plants filed with the Jackson Office of the Mississippi Department of Agriculture and Commerce, and the Gulfport Office of the Agricultural Statistician, Bureau of Agricultural Economics. These reports cover producers supplies of milk and butterfat in cream and the products manufactured by these plants.

Supply and use data are presented for a 10-year period, 1939 through 1948, for condenseries, cheese plants, and creameries. This report also includes similar information for wholesale ice cream plants from 1944 through 1948.

Classification of Plants

Dairy manufacturing plants were classified according to the major use made of their total receipts. Plants using the major portion of their producer supplies for the making of cheese were classified as cheese plants. Plants using most of their milk supplies for the manufacture of evaporated or condensed milk were classified as condenseries. Similarly, creameries were classified according to the amount of receipts going into the making of butter. Ice cream plants were those that used the major portion of their supplies for the making of ice cream. Although in most cases individual plants were engaged in the processing of several dairy products, they based their operations on the manufacture of one product. These manufacturing plants supplied bulk milk and cream to fluid plants and other processing plants, as well as supplying consumers directly with bottled cream and milk. This use of whole milk was a relatively small proportion of total use and was important primarily only during the fall and winter months.

Another current study by the Mississippi Agricultural Experiment Station reports supply and use data for fluid milk plants.[3] These plants also produce small quantities of manufactured dairy products.

Condenseries

Location

Five of the six condenseries in Mississippi were located in the northeast section of the state. This area has been developed to a considerable extent as a dairy manufacturing area. Small farms and small herds are characteristic of this and other manufacturing areas in the state. The other condensery was located in south-

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[2] Parvin, D. W., Development of the Dairy Industry in Mississippi, Mississippi Experiment Station Bulletin 422, July 1945.

[3] Garbarino, A. J., "Marketing of Fluid Milk In Mississippi." (A thesis submitted in partial fulfillment of the requirements for the Degree of Master of Science).

[4] Includes plants whose major use of milk is either condensed or evaporated milk.

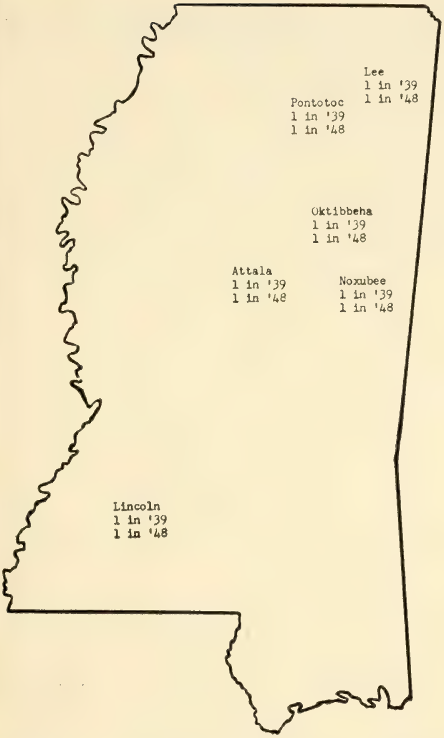

Figure 1. Location of dairy plants in which the major use of milk supplies was for condensed or evaporated milk, Mississippi, 1939 and 1948.

west Mississippi. It was one of the largest dairy manufacturing plants in the southern part of the state, and provided a ready outlet for the summer surpluses of fluid milk from cooling stations in the New Orleans milkshed, as well as from small producers in its vicinity.

Number Of Plants And Annual Producer Supplies Of Whole Milk

There was no change in number of condenseries in Mississippi from 1939 to 1948 (Table 1). The 6 plants were the largest in the state and required large capital investments. They were not closed and re-opened or their type of operation was not shifted to the extent that has been true of cheese plants, creameries, and ice cream plants.

Condenseries bought more manufacturing grade milk from producers than any other type of dairy processing plant in Mississippi. In 1948, these plants received approximately 142 million pounds of milk from producers (Table 1). This was about 40 percent more than the quantity received by cheese plants and about 8 times the amount received by creameries.

Receipt of milk from producers increased over 10 percent from 1939 to 1948. There was a steady increase in volume from 1939 to 1945 when receipts reached almost 190 million pounds. From 1946 through 1948, supplies remained around the 140 million total. Other than the exceptionally good production years of 1944 and 1945, annual supplies have been relatively stable since 1942.

Seasonality Of Producer Supplies

There is a great deal of summer dairying in the production areas that supply condenseries. Operators of small farms keep a few cows as a supplement to other farming activities and do not breed or feed cows for fall and winter production.

Because of the pattern of production, condenseries receive 60 to 65 percent of their producer supplies during the 5-month period April through August, and over 75 percent from March through September. This means that for at least 5 months of the year, plants can operate only a few hours per day and that many problems arise from this seasonal pattern of supply. When the war and post-wars years are compared to the period before the war, 1939-41, it may be noted that producers

Table 1. Number of Condenseries and Supplies of Milk from Producers, Mississippi, 1939-48.

Year	Number of plants	Receipts
		Cwt. of milk
1939	6	1,232,269
1940	6	1,072,260
1941	6	1,341,286
1942	6	1,485,152
1943	6	1,477,565
1944	6	1,701,037
1945	6	1,889,907
1946	6	1,487,074
1947	6	1,400,335
1948	6	1,420,301

Table 2. Seasonal Index*, Whole Milk Received from Producer, Condenseries, Mississippi, 1939-48.

Month	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948
					Average month=100					
January	----	51	54	60	60	57	53	44	46	43
February	----	58	57	67	71	66	62	53	59	47
March	----	69	64	78	80	85	84	79	66	70
April	----	100	102	120	125	117	117	137	105	121
May	----	139	134	139	144	141	140	153	159	155
June	----	141	128	148	146	148	149	157	166	144
July	148	142	149	159	144	144	148	157	173	148
August	136	151	153	141	121	140	137	140	138	----
September	107	129	127	118	97	117	143	107	115	----
October	86	98	96	92	86	78	72	72	81	----
November	68	70	75	75	68	63	54	56	52	----
December	55	52	61	57	58	44	41	45	40	----

*Computed by 12 months moving average centered on seventh month.

supplies of milk have become more and more concentrated in the summer months, and that receipts during fall and winter months have become relatively smaller(Table 2).

Certain changes are noticeable in receipts of producer supplies by condenseries in recent years. In 1946 and 1947, they received 62 percent of their supplies during the 5-month period, April through August and 78 percent during the flush production months, March through September. In contrast, it is observed that during an earlier period 1939 to 1941, condenseries received approximately 55 percent of their total producer supplies during the 5 months, April through August, and about 70 percent from March through September. A few reasons for this are that during the last 5 or 6 years farm incomes have been at record levels and producers have not cared for herds as they were forced to do prior to the war. Also, during the last 10 years, many producers in manufacturing areas have shifted to the production of Grade A milk. Price differentials have been very favorable to this shift. From observation and from conversation with plant managers, it may be inferred that those who shifted were producers whose production patterns corresponded more closely to the relatively stable demand for bottle milk. These were usually the larger producers. This creates further supply problems for condenseries as well as other manufacturing plants, since the supplies of new producers constantly coming in are usually more seasonal than those shifting to Grade A production.

Producer Price

Prices paid producers by condenseries more than tripled between 1939 and 1948, increasing from $.30 per pound of butterfat to $.99 per pound. Since these prices do not include subsidy payments, this trend was interrupted from 1943-45 when prices were controlled by the office of the Price Administrator (Table 3). Prices started down in the fall of 1948 and will probably tend to stabilize at a level lower than those prevailing in 1947 and 1948 as supply and demand become better adjusted. The lack of change from month to month in prices paid producers

Table 3. Prices Paid Producers by Condenseries Per Pound of Butterfat in Whole Milk, Mississippi, 1939-48.

Year	Price per pound
	Dollars
1939	.30
1940	.35
1941	.40
1942	.50
1943	.67
1944	.69
1945	.67
1946	.85
1947	.89
1948	.99

stands out particularly during the war years 1943-45 (Table 4). The pattern of receipts during the 10 years studied indicates that the differential in prices from season to season was not large enough to encourage farmers to maintain fall production. Seasonal variations in prices paid producers were approximately the same from 1939 through 1942 as in the post war period 1946 through 1948.

Conversion Of Data Used

In addition to information concerning producer supplies of butterfat and cream for condenseries and other processing plants, annual reports also included information on products manufactured by condenseries and other dairy manufacturing plants. From this utilization data butterfat use was computed by conversion factors appearing in Appendix Table 1. For the first 4 years of the period studied, plants reported use of butterfat in butter, ice cream, and cheese so that these conversion factors could be checked for accuracy. These conversion factors were also checked by and obtained from plant managers and from the Dairy Department, Mississippi State College.

The surplus figure appearing in the discussion of butterfat supply and use in condenseries is the calculated quantity of butterfat above producer supplies that was not used by these processing plants. This calculated quantity does not include butterfat in cream or whole milk obtained from other plants. Surplus butterfat would be increased by the amount received from sources other than producers.

Surplus or deficit amounts discussed for other groups of plants included in this report were calculated in the same manner as for condenseries.

Use Of Butterfat

The pattern of butterfat use in condensing plants changed considerably over the 10 years studied. Almost 15 percent of total butterfat receipts was processed as butter from 1939 through 1941, while less than 6 percent went into this product during 1946 through 1948. Larger portions of butterfat receipts were used in condensed milk, 63 percent during the former period and 70 percent during the latter years (Tables 5 and 6). Butterfat in milk sold for direct consumption was an important part of use during the war-time period because of the great shortage of milk for bottling purposes. It is doubtful that these large manufacturing plants will add fluid distributing departments to their plant operation in normal times. The smaller price differential between manufacturing milk and bottling grade milk that exists in normal times will not be large enough to make the addition of a fluid department profitable or the volume

Table 4. Seasonal Index*, Prices Paid Producers by Condenseries per Pound of Butterfat in Whole Milk, Mississippi, 1939-48.

Month	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948
					Average month=100					
January	----	109	99	110	106	103	97	96	107	107
February	----	105	95	107	104	103	98	99	102	105
March	-- -	102	93	103	103	104	102	95	101	100
April	----	96	96	100	103	101	102	92	101	100
May	----	90	99	98	101	101	101	88	90	100
June	----	93	103	92	101	99	103	88	89	102
July	97	92	107	92	101	98	104	103	94	107
August	94	96	105	96	100	98	104	103	97	----
September	102	94	107	98	98	99	96	105	102	-- -
October	106	100	104	101	96	98	98	110	101	----
November	107	108	102	100	93	99	97	112	107	- -
December	111	115	100	103	94	97	98	109	109	----

*Computed by 12 months moving average centered on seventh month.

Table 5. **Producer Supplies of Butterfat in Milk and Cream, and Total Use of Butterfat, Condenseries, Mississippi, 1939-48.**

Year	Producer Supplies			Total use					
	Milk	Cream	Total	Butter	Ice cream	For direct consumption	Condensed products	Surplus supply	Total
		Cwt. of butterfat					Cwt. of butterfat		
1939	56,232	729	56,961	7,040	632	421	35,537	13,331	56,961
1940	49,078	547	49,625	6,741	632	----	31,731	10,520	49,625
1941	60,685	742	61,427	7,579	794	1	38,702	14,349	61,427
1942	67,644	718	68,362	3,389	884	1,648	43,956	18,485	68,362
1943	67,176	1,227	68,403	3,389	647	7,792	36,460	19,636	68,403
1944	71,968	325	72,293	7,368	823	6,559	45,066	12,477	72,293
1945	82,794	.	82,794	5,206	643	2,938	50,120	23,887	82,794
1946	66,461	----	66,461	748	1,129	533	47,319	16,752	66,461
1947	63,040	----	63,040	2,016	864	402	43,185	15,573	63,040
1948	64,823	----	64,823	2,165	628	----	45,580	16,450	64,823

Table 6. **Portion of Producer Butterfat Supplies from Milk and Cream, and Use of Butterfat Expressed as a Percent of Producer Supplies, Condenseries, Mississippi, 1939-48.**

Year	Producer Supplies			Total use					
	Milk	Cream	Total	Butter	Ice cream	For direct consumption	Condensed products	Surplus supply	Total
		Percent					Percent		
1939	99	1	100	12	1	1	62	23	100
1940	99	1	100	14	1	..	64	21	100
1941	99	1	100	13	1	..	63	23	100
1942	99	1	100	6	1	2	64	27	100
1943	99	1	100	6	1	11	53	29	100
1944	100	*	100	11	1	9	62	17	100
1945	100	..	100	6	1	3	61	29	100
1946	100	..	100	1	2	1	71	25	100
1947	100	..	100	4	1	1	69	25	100
1948	100	..	100	4	1	..	70	25	100

*Less than 1 percent.

handled by these plants great enough to be of importance as a use of butterfat.

Because condenseries standardize milk at less than 4 percent butterfat before processing it into condensed milk, they have considerable quantities of butterfat available for other uses within their own plants and for sale to other plants. The surplus shown in Tables 5 and 6 was derived by computing the total use of butterfat by these plants and subtracting this sum from total producer receipts. The resulting quantity represents the net amount of producer supplies available for sale to creameries and other manufacturing plants by condenseries. The purchasing of butterfat from other plants by condenseries would increase the surplus supply by the amount of these receipts. During the 10-year period studied, these plants did not process 20 to 30 percent of their producer supplies of butterfat according to these calculations. Condenseries had over a million pounds of butterfat available for use by other plants during each year from 1939 through 1948, and over one and one-half million pounds available during the last 4 years studied. These plants sold this excess butterfat to plants located in adjoining states as well as to other plants in the state. Additional research is needed to ascertain the exact channels of distribution and the most economical methods of handling this movement of butterfat in cream.

Seasonal Use Of Butterfat

In the 7-year period 1939 through 1945, butterfat used in products other than condensed milk was over twice as important as during the 3 years 1946 through 1948. Use of butterfat in butter and other products makes the seasonal pattern of use quite different in the two periods. During most of the former period larger proportions of producer receipts of butterfat were used during fall and winter months than during spring and summer months, while in the latter period this pattern was reversed and greater proportion of producer receipts of butterfat were available for sale to other plants during the winter than during the summer months. The proportion of producer supplies available for sale in any given month may be computed by subtracting the percentage figure for this month in Table 7 from 100.

Seasonal Use of Butterfat in Condensed Milk

From 1939 to 1945, condensed milk accounted for a greater proportion of the butterfat processed by condenseries in the summer months than during the fall and winter months (Table 8). Although these plants did not process greater quantities of butterfat into butter and other products during the fall and winter months than in summer months, they accounted for greater proportion of the butterfat used by condenseries, because higher fat content in milk receipts during the winter months left relatively less skim product available for use in condensed milk. From 1945 through 1948, these plants made little use of butterfat for products other than condensed milk. The proportion of butterfat processed into condensed products during these years did not vary to the extent that it did in previous years. However, the tendency again was the use of relatively smaller proportion of butterfat supplies in condensed milk during the fall and winter months.

Table 7. Butterfat Processed by Condenseries Expressed as a Percent of Producer Supplies, Mississippi, 1939-48.

Season	1939-41	1942-45	1946-48
		Percent	
Jan.-March	84	74	69
Apr.-June	79	78	79
July-Sept.	75	72	74
Oct.-Dec.	79	71	66
	—	—	—
Year	78	74	75

Table 8. Portion of Total Butterfat Processed Used in Condensed Milk, Condenseries, Mississippi, 1939-48.

Season	1939-41	1942-45	1946-48
		Percent	
Jan.-March	83	78	93
Apr.-June	84	82	96
July.-Sept.	82	86	93
Oct.-Dec.	77	74	91
	—	—	—
Year	81	81	93

Seasonal Availability of Fat for Sale

The season of the year that condenseries have the greatest quantities of producer butterfat receipts for sale depend upon seasonality of producer supplies of whole milk, and on the use that these plants make of this part of whole milk receipts. During the years and season in which the major use of butterfat was condensed milk, larger quantities of producer receipts of butterfat were available for sale during the fall and winter months than during those periods when considerable quantities of butterfat were processed into other dairy products. From 1939 through 1941, when approximately 80 percent of the butterfat processed by condenseries went into condensed milk, only 30 percent of the annual butterfat receipts not processed were available for sale from October through March. From 1946 through 1948, when over 90 percent of the butterfat processed went into condensed milk, slightly over 40 percent of the total producer receipts for sale by condenseries was available during this fall and winter period (Table 9). The season of the year in which these supplies are available is of importance to creameries, ice cream plants and other types of manufacturing plants where problems in obtaining butterfat supplies to carry on their operations are present.

Producer Supplies Of The Skim Portion Of Whole Milk

Although no effort was made to determine the extent of capacity at which condenseries operated during the various seasons of the year, the data collected show that they could not have operated anywhere near capacity during at least 7 months of the year because of the seasonal pattern of producer supplies.

Table 9. Percent of Annual Surplus Producer Supplies of Butterfat for Sale, Condenseries, Mississippi, 1939-48.

Season	1939-41	1942-45	1946-48
		Percent	
Jan.-March	11	16	18
Apr.-June	29	28	28
July-Sept.	38	36	30
Oct.-Dec.	22	20	24
	—	—	—
Year	100	100	100

Since these plants are users of all the skim part of whole milk receipts, and are dependent on it in their operations as condenseries, the seasonality of supplies of whole milk is important. Any educational program that will help in leveling or increasing producer supplies of whole milk will help solve many problems in the operation of condenseries and other dairy manufacturing plants in Mississippi.

Cheese Plants

Location

Cheese plants in Mississippi are located in the Northeast area of the state, in the same general areas as condenseries. These cheese plants are located in this area of relatively dense cow population where the greater part of milk production is for manufacturing purposes. There was some shift in location of these plants between 1939 and 1948 (figure 2). Cheese plants tended to shift their operations nearer to the concentrations of milk production and had moved to new areas of manufacturing milk production. These plants must remain relatively near their source of supply, since they require whole milk for making cheese and other dairy products.

Number Of Plants And Annual Producer Supplies Of Whole Milk

The number of cheese plants was relatively stable during the 10 years being studied (Table 10). Seventeen plants operated during 1939, 15 during 1940, 1943, and 1948 and 14 plants used the major portion of their milk receipts in cheese during the remaining 6 years. Most of the cheese plants in Mississippi were owned by large dairy manufacturing companies, and when producer receipts in an individual plant fell to a level that made efficient operation seem impossible, plants were closed and the remaining supply shifted to other plants under the same ownership. This fact and the relatively low investment in facilities, as compared to condenseries, accounted for the change in number of plants from year to year.

Table 10. Number of Cheese Plants and Supplies of Whole Milk from Producers, Mississippi, 1939-48.

Year	Number of plants	Receipts
1939	17	844,446
1940	15	701,823
1941	14	961,897
1942	14	927,316
1943	15	895,569
1944	14	1,133,153
1945	14	1,292,487
1946	14	1,084,700
1947	14	1,076,506
1948	15	1,048,677

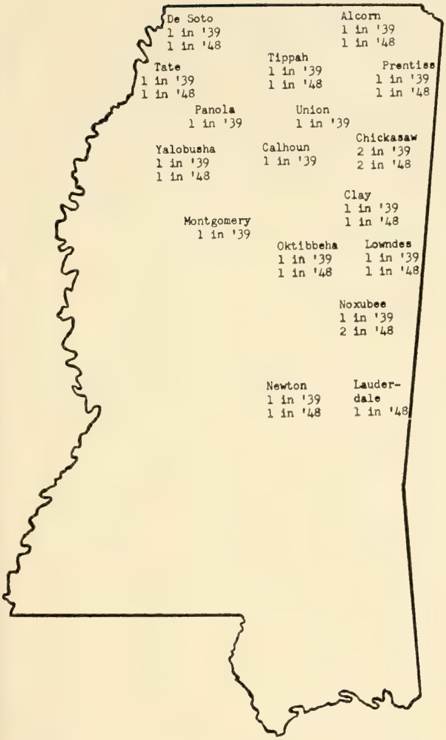
De Soto
1 in '39
1 in '48
Alcorn
1 in '39
1 in '48
Tippah
1 in '39
1 in '48
Tate
1 in '39
1 in '48
Prentiss
1 in '39
1 in '48
Panola
1 in '39
Union
1 in '39
Chickasaw
2 in '39
2 in '48
Yalobusha
1 in '39
1 in '48
Calhoun
1 in '39
Clay
1 in '39
1 in '48
Montgomery
1 in '39
Oktibbeha
1 in '39
1 in '48
Lowndes
1 in '39
1 in '48
Noxubee
1 in '39
2 in '48
Newton
1 in '39
1 in '48
Lauder-
dale
1 in '48

Figure 2. Location of dairy plants in which the major use of milk supplies was for cheese, Mississippi, 1939 and 1948.

Cheese plants received approximately 20 percent more milk from producers in 1948 than during 1939, nearly 84 million pounds in the latter year and almost 105 million pounds in the former. As was true of condenseries, producer receipts at cheese plants increased until they reached their peak of 129 million pounds in 1945. Annual supplies during 1946 through 1948 were relatively stable, varying from approximately 108 million pounds of milk in 1946 to almost 105 million in 1948 (Table 10).

Seasonality Of Producer Supplies

Since the same production areas serve both cheese plants and condenseries, the same factors affecting seasonality were present over the 10-year period, 1939 through 1948. Approximately 55 percent of total producer supplies were received by cheese plants during the 5 months April through August, during 1940 and 1941, while approximately 65 percent of total producer supplies were received during these months for 1946 and 1947. This indicates that producer milk receipts at cheese plants were becoming more and more concentrated in the summer months (Table 11).

Although cheese plants and other manufacturing plants do not require level supplies to the extent that is true in fluid milk plants, this extreme seasonal pattern of receipts causes many problems in the utilization of plant facilities, labor, and storage facilities.

Producer Prices

As in the case of condenseries, prices paid producers per pound of butterfat by cheese plants more than tripled from

Table 11. Seasonal Index*, Whole Milk Received from Producers, Cheese Plants, Mississippi, 1939-48.

Month	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948
					Average Month=100					
January	....	40	46	54	49	49	48	37	41	37
February	.	47	50	58	63	63	65	53	59	46
March		52	50	62	68	72	73	69	59	60
April	....	76	81	100	113	102	111	127	89	107
May	....	144	143	160	169	179	156	175	164	165
June	..	154	136	152	163	161	147	157	176	152
July	158	155	149	155	151	142	192	153	171	147
August	163	171	161	148	120	139	148	153	151	....
September	106	140	133	116	92	111	105	109	117	....
October	84	104	107	80	85	73	73	69	87	...
November	67	70	81	68	74	62	49	56	49	...
December	51	47	63	47	53	47	33	42	37	..

*Computed by twelve months moving average centered on seventh month.

1939 through 1948 (Table 12). Prices paid producers by cheese plants were approximately the same as for condenseries except during the 3 years, 1943 through 1945, when they were from 6 to 8 cents lower than condensery prices.

Prices paid producers were very stable from season to season during the wartime period of price control (Table 13). Although there was evidence of higher prices being paid during the seasons of short supply both before and after the war, the data on changes in the seasonal pattern of producer receipts indicated that this variation of price did little toward making producer deliveries more even throughout the year. It is difficult to measure the effect of the stability of prices from season to season during the war years on producer deliveries during the last 3 years included in the study. It is possible however, that this lack of price change may have contributed to the increasing amounts of producer deliveries during the spring and summer months of the period following the war. This conclusion is valid only to the extent that there is a lag in the effect of price on production.

Table 12. Prices Paid Producers by Cheese Plants, per Pound of Butterfat in Whole Milk, Cheese Plants, Mississippi, 1939-48.

Year	Price per pound
	Dollars
1939	.30
1940	.34
1941	.39
1942	.49
1943	.60
1944	.61
1945	.59
1946	.84
1947	.82
1948	.99

Use Of Butterfat

The major change in the year-to-year pattern of butterfat utilization by cheese plants was the use of greater proportions of supplies for the manufacture of cheese, 61 percent of total plant supplies being used for cheese in 1939 as compared to 74 percent in 1948 (Tables 14 and 15). Use of butterfat in butter declined from 19 percent of the total supply of butterfat in 1939 to 14 percent of the total in 1948. There was a slight increase in the utilization of butterfat in ice cream, although this use accounted for only 4 percent of the total by 1948. Because of the increased use of butterfat in cheese, cheese plants had a smaller portion of butterfat receipts available for sale to other plants during the post-war years than prior to the war. According to the calculations based on the butterfat conversion factors appearing in Appendix Table 1, from 700- to 800-thousand pounds of producer butterfat receipts were available for sale to other

Table 13. Seasonal Index*, Prices Paid Producers by Cheese Plants, per pound of Butterfat in Whole Milk, Mississippi, 1939-48.

Month	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948
					Average Month=100					
January	----	108	101	105	103	101	102	97	107	105
February	----	108	95	103	103	103	103	100	102	104
March	----	104	94	101	102	103	103	95	102	100
April	----	100	93	97	103	101	102	88	102	100
May	----	94	97	99	98	98	100	89	90	101
June	----	94	98	94	95	98	102	89	91	106
July	96	93	103	91	99	98	99	102	93	107
August	94	93	105	96	100	99	99	100	96	----
September	99	95	106	101	99	98	99	102	99	----
October	106	98	104	103	99	100	98	108	102	----
November	107	102	103	105	98	100	97	114	104	----
December	109	111	102	105	101	100	96	116	112	----

*Calculated by 12 months moving average centered on the seventh month.

Table 14. Producer Supplies of Butterfat in Milk and Cream, and Total Use of Butterfat, Cheese Plants, Mississippi, 1939-48.

Year	Producer supply			Total use					
	Milk	Cream	Total	Butter	Ice cream	Direct consumption	Cheese	Surplus supply	Total
		Cwt. of Butterfat					Cwt. of Butterfat		
1939	37,111	7,069	44,180	8,539	360	325	26,940	8,016	44,180
1940	30,994	4,925	35,919	5,139	444	248	23,044	7,044	35,919
1941	43,270	6,577	49,847	6,981	558	262	31,388	10,658	49,847
1942	40,772	10,007	50,779	7,965	659	449	34,546	7,160	50,779
1943	39,755	3,536	43,291	7,218	681	1,326	28,688	5,378	43,291
1944	49,583	2,125	51,708	6,829	548	1,170	36,197	6,964	51,708
1945	53,508	4,798	58,306	5,940	1,938	----	40,715	9,713	58,306
1946	46,848	4,691	51,535	5,147	3,271		36,114	7,003	51,535
1947	47,403	1,006	48,408	7,457	1,088	500	37,058	2,801	48,409
1948	47,905	1,179	49,084	7,061	1,522		36,515	3,986	49,084

Table 15. Portion of Producer Butterfat Supplies from Milk and Cream and Use of Butterfat Expressed as a Percent of Producer Supplies, Cheese Plants, Mississippi, 1939-48.

Year	Producer supply			Total use					
	Milk	Cream	Total	Butter	Ice cream	Direct consumption	Cheese	Surplus supply	Total
		Percent					Percent		
1939	84	16	100	19	1	1	61	18	100
1940	86	14	100	14	1	1	64	20	100
1941	87	13	100	14	1	1	63	21	100
1942	86	14	100	16	1	1	68	14	100
1943	92	8	100	17	2	3	66	12	100
1944	96	4	100	13	1	2	70	14	100
1945	92	8	100	10	3	--	70	17	100
1946	91	9	100	10	6	--	70	14	100
1947	98	2	100	15	2	--	77	6	100
1948	98	2	100	14	4	--	74	8	100

types of plants during 1939 and 1940, and from 300- to 400-thousand pounds during 1947 and 1948. Cheese plants sold this unused butterfat to creameries, ice cream plants, and fluid milk plants in the state and also shipped large quantities to dairy plants in adjoining states.

Seasonal Use Of Butterfat

Cheese plants processed greater proportion of producer supplies of butterfat during the spring and summer months of each year than during the fall and winter period (Table 16). This is the pattern that one might expect in dairy manufacturing plants that are affected more by receipts of the skim equivalent of whole milk than by the butterfat equivalent. As in condenseries, cheese plants standardized whole milk processed into their major product at a lower butterfat content than was present when received from producers. This means that larger proportions of butterfat supplies are available for sale during seasons of high butterfat content than during the spring and summer months when butterfat content is nearer the standard used in cheese making.

Seasonal Use Of Butterfat In Cheese

Although there was some variation, cheese plants processed approximately 80 percent of the fat used in their plants into cheese (Table 17). These changes were brought about primarily by changes in price relationships between the various products processed by these plants. Cheese

Table 16. Butterfat Processed by Cheese Plants Expressed as a Percent of Total Producer Butterfat Supplies, Mississippi, 1939-48.

Season	1939-41	1942-45	1946-48
		Percent	
Jan.-March	79	82	83
Apr.June	82	89	93
July-Sept.	81	87	92
Oct.-Dec.	78	81	88
	—	—	—
Year	80	86	88

Table 17. Portion of Total Fat Processed into Cheese, Cheese Plants, Mississippi, 1939-48

Season	1939-41	1942-45	1946-48
		Percent	
Jan.-March	67	76	82
Apr.-June	83	82	85
July-Sept.	80	82	81
Oct.-Dec.	73	75	76
	—	—	—
Year	78	80	81

plants made maximum use of butterfat in processing cheese during the spring and summer months when the butterfat content of whole milk receipts was relatively low. During the fall and winter months, butter and ice cream accounted for a greater proportion of the butterfat processed because of a shortage of the skim portion of whole milk for making cheese.

Seasonal Availability of Butterfat for Sale

There was some year-to-year variation in the season of the year in which cheese plants had greater quantities of producer butterfat receipts available for sale. The computations made in this study show that they usually had available 55 to 60 percent of the annual total from April through September (Table 18). Even though greater proportions of producer receipts of butterfat were used during these spring and summer months, the larger quantities of butterfat in whole milk received from producers left greater amounts of butterfat available for sale to other plants. Cheese plants have greater quantities of butterfat for sale during the period in which other plants have their heaviest receipts. However, the needs of creameries and ice cream plants, both in and out of the state, make the distribution of surplus butterfat during the summer relatively easy under existing supply conditions.

Producer Supplies of Skim Portion of Whole Milk

Cheese plants, like condenseries, make use of all the skim portion of whole milk received from producers. Operations of the plants are affected more by the seasonal pattern of producer receipts of the skim part of whole milk than by the receipts of the butterfat portion. Cheese plants did not have enough whole milk receipts to operate their plants full-time for at least 6 months of the year.

Table 18. Percent of Annual Surplus Producer Suppplies of Butterfat for Sale, Cheese Plants, Mississippi, 1939-48.

Season	1939-41	1942-45	1946-48
		Percent	
Jan.-March	15	19	24
Apr.-June	26	26	23
July-Sept.	35	30	30
Oct.-Dec.	24	25	23
	—	—	—
Year	100	100	100

Creameries

Location

Creameries were located in 3 areas of Mississippi in 1939—Northeast Mississippi, Central Mississippi, and the Upper Brown Loam Area. These plants were still located in the same areas in 1948, but only a few of the larger plants had continued operation primarily as butter making plants (figure 3). Competition from other plants for milk supplies and the relatively low price for butter as compared to other manufactured dairy products had resulted in many of these plants going out of business or shifting their operations to the processing of products other than butter.

Number of Plants and Annual Producer Supplies

The number of plants processing the greater part of their supplies as butter dropped from 11 in 1939 to 4 in 1948 (Table 19). Small plants have not been able to meet the competition of the larger butter making companies because of the lack of merchandising ability and the impossibility of carrying on selling programs comparable to those of larger butter manufacturing plants. Several of these plants had lost their producers due to increased demand for fluid milk supplies, because they were not able to meet competition of fluid plants. They have gone out of business altogether or have become fluid milk plants or ice cream plants.

Creameries received about three and one-half times as much whole milk in 1948 as in 1939, increasing from approximately 5 million pounds in 1939 to over 18 million pounds in 1948 (Table 19). In later discussion, it will be pointed out that these receipts of whole milk took the place of receipts of cream to a great extent.

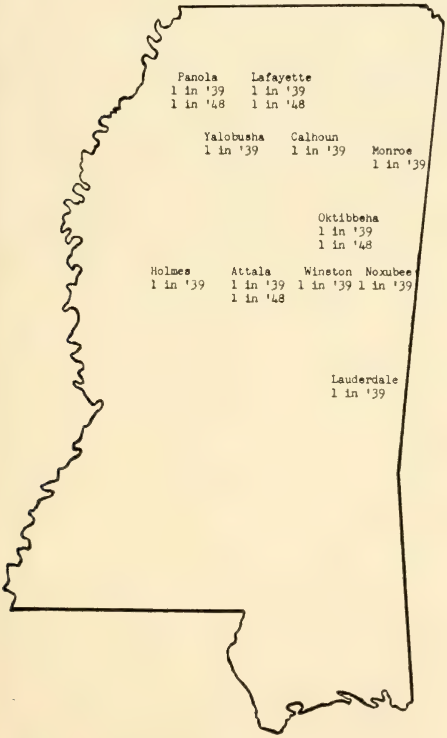

Figure 3. Location of dairy plants in which the major use of milk supplies was for butter, Mississippi, 1939 and 1948.

Seasonality of Producer Supplies

As in the case of condenseries and cheese plants, producer supplies of milk at creameries became more and more seasonal over the 10-year period studied (Table 20). During 1940 and 1941, creameries received approximately 55 percent of their annual receipts of whole milk from April through August, and almost 72 percent from March through September. In 1946 and 1947, creameries received about 65 percent of their total producer whole milk receipts from April through August, and almost 80 percent from March through September. This trend is particularly important, since producer cream supplies decreased until they were less than one-sixth as large in 1948 as in 1939. This change in the supply pattern left less whole milk and butterfat available for operation during the winter months and created an even more serious supply problem than in former years.

Producer Prices

Prices paid producers by creameries per pound of butterfat in whole milk increased from $.35 in 1939 to $.97 in 1948 (Table 21). During most of the period studied, creameries paid slightly higher

Table 19. Number of Creameries and Supply of Whole Milk from Producers, Mississippi, 1939-48.

Year	Number of Plants	Receipts
1939	11	49,354
1940	10	57,203
1941	10	68,049
1942	8	71,262
1943	7	80,994
1944	7	145,350
1945	6	164,948
1946	7	177,053
1947	7	158,978
1948	4	184,372

Table 20. Seasonal Index*, Whole Milk Received from Producers, Creameries, Mississippi, 1939-48.

Month	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948
				Average month = 100						
January	----	46	50	47	48	57	47	44	42	47
February	----	56	53	59	68	71	61	53	57	55
March	----	66	65	70	77	92	84	80	72	82
April	----	101	99	114	119	123	131	138	120	131
May	----	135	125	144	160	161	151	160	166	164
June	--	140	109	147	151	154	161	168	175	146
July	145	146	150	153	152	142	151	167	167	148
August	120	153	173	141	127	130	142	144	132	----
September	116	126	134	124	101	111	105	103	108	----
October	91	100	108	84	89	70	74	62	71	----
November	72	76	79	65	59	49	52	44	45	----
December	63	55	55	52	49	40	41	37	45	----

*Computed by 12 months moving average centered on seventh month.

prices for butterfat than did cheese plants and condenseries because of higher prices for Grade A milk deliveries by producers. This tends to indicate the favorable position of butter as an alternative outlet for butterfat during this period. It also may indicate that a quality product was being produced.

As in other dairy manufacturing plants in Mississippi, prices paid producers by creameries varied more from season to season before and after the war than during the war-time period of price control (Table 22). The stability of price during this 3-year period probably had some effect on making producer supplies more seasonal after the war than before the war. Probably factors such as producers shifting to Grade A production tended to outweigh the factor of price variation.

Table 21. Prices Paid Producers by Creameries, per Pound of Butterfat in Whole Milk, Mississippi, 1939-48.

Year	Price
1939	.35
1940	.37
1941	.46
1942	.53
1943	.67
1944	.70
1945	.70
1946	.85
1947	.90
1948	.97

Use of Butterfat

Use of butterfat by creameries changed a great deal from 1939 through 1948. During the first 5 years of this period almost all fat used by creameries went into butter while during the last half of this 10-year period, increased quantities and proportions of fat receipts went into ice cream and whole milk for direct consumption (Table 23 and 24). This indicates that these plants had been shifting their operations from primarily buttermaking to a combination of dairy processing enterprises. Whether or not this trend will continue will depend primarily on the relative price of the products that may be processed by these plants.

According to data calculated by computing butterfat use from products manufactured, creameries used quantities of butterfat in excess of producer supplies during each of the 10 years studied. These plants purchased almost one and one-fourth million pounds of butterfat from other plants in 1939 and approximately one-half million pounds in 1940 and 1941, as compared to over one-half million pounds in 1946 and 1947 and slightly over one-fourth million pounds in 1948. These plants were good markets for surplus butterfat from condenseries and cheese plants, particularly in their processing of butter and ice cream and will become even better markets for butterfat if they return to butter as the primary use of butterfat.

Seasonal Use of Butterfat

Creameries purchased butterfat from other plants during all months of the 10 years included in this study (Table 25). These plants buy larger quantities of butterfat from sources other than producers

Table 22. Seasonal Index*, Prices Paid Producers by Creameries, per Pound of Butterfat in Whole Milk, Mississippi, 1939-48.

Month	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948
					Average month = 100					
January	----	109	99	107	106	104	102	100	104	94
February	----	106	94	102	103	101	102	92	101	100
March	----	103	96	100	100	103	100	96	101	98
April	----	94	96	97	98	100	100	93	100	93
May	----	89	96	97	101	100	99	89	95	100
June	----	91	98	93	92	99	100	90	92	102
July	92	95	101	93	102	99	99	104	91	107
August	85	96	103	97	102	99	99	102	95	----
September	103	97	105	99	98	100	99	103	98	----
October	106	99	105	102	100	98	99	109	102	----
November	124	106	104	103	99	100	99	113	107	----
December	132	115	103	110	99	97	102	109	114	-

*Computed by 12 months moving average centered on seventh month.

Table 23. Producer Supplies of Butterfat in Milk and Cream, and Total Use of Butterfat, Creameries, Mississippi, 1939-48.

Year	Producer supplies			Total use				
	Milk	Cream	Total	Direct consumption	Ice cream	Butter	Total	Deficit
	Cwt. of butterfat					Cwt. of butterfat		
1939	2,218	15,803	18,021	119	565	29,664	30,349	12,328
1940	2,576	17,957	20,533	----	655	25,261	25,916	5,388
1941	3,256	20,380	23,636	215	929	28,041	29,185	5,549
1942	3,175	18,138	21,313	864	1,334	21,796	23,994	2,681
1943	3,698	15,889	19,587	301	1,561	19,190	21,052	1,465
1944	6,404	16,627	23,031	606	3,433	21,456	25,495	2,464
1945	7,501	12,553	20,054	1,083	3,065	18,587	22,735	2,679
1946	7,864	8,317	16,181	1,755	5,690	15,229	22,674	6,491
1947	7,062	7,086	14,148	1,183	4,125	13,495	18,803	4,655
1948	8,338	2,496	10,834	2,393	2,008	8,179	13,580	2,746

Table 24. Producer Supplies of Butterfat Receipts in Milk and Cream and Use of Butterfat Expressed as a Percent of Producer Supplies, Creameries, Mississippi, 1939-48.

Year	Producer supplies			Total use				
	Milk	Cream	Total	Direct consumption	Ice cream	Butter	Total	Deficit
	Percent					Percent		
1939	12	88	100	1	3	165	169	69
1940	13	87	100	.	3	165	169	69
1941	14	86	100	1	4	119	124	24
1942	15	85	100	4	6	103	113	13
1943	19	81	100	2	8	98	108	8
1944	28	72	100	3	15	93	111	11
1945	37	63	100	5	15	93	113	13
1946	49	51	100	11	35	94	140	40
1947	50	50	100	8	29	95	132	32
1948	77	23	100	22	28	75	125	25

during the spring and summer months than during the fall and winter period. Since the seasonal pattern of butterfat receipts was such that a great part of total fat supplies from producers was received during 5 months of the year, this indicates that creameries operated a highly seasonal business. However, this tends to simplify to some extent the distribution of the surplus quantities of butterfat from condenseries and cheese plants during the flush production season.

Seasonal Use of Butterfat in Butter

Creameries tended to use smaller proportions of their total butterfat receipts in butter over the period 1939 through 1948. Over 95 percent of total butterfat receipts was used in butter from 1939 through 1941, while an average of 66 percent of total receipts was used in this product from 1946 through 1948. From 1939 through 1943, when approximately 90 percent of total butterfat use in creameries was for butter, there was little difference in the proportion of total butterfat receipts going into butter from month to month. When greater proportions of total butterfat receipts began to be used for ice cream and for direct consumption, greater percentages of butterfat receipts were used in butter during the spring and summer than during the fall and winter. This pattern of butterfat use was particularly evident from 1946 through 1948 (Table 26).

Seasonal Purchasing of Fat from Other Plants

Creameries purchased greater quantities of butterfat from other plants during the spring and summer months than during the fall and winter. From 60 to 65 percent of the annual purchases of butterfat were made during the 6 months April through September during most of the years from 1939 through 1948 (Table 27). This was due, to a great extent, to the greater quantities of butterfat other plants had available during this flush production period. Because producer supplies were also highest during this same period, creameries operated a highly seasonal business.

Table 25. Butterfat Processed by Creameries Expressed as a Percent of Producer Supplies, Mississippi, 1939-48.

Season	1939-41	1942-45	1946-48
		Percent	
Jan.-March	144	109	143
Apr.-June	135	109	132
July-Sept.	141	114	130
Oct.-Dec.	140	115	134
Year	140	111	133

Table 26. Portion of Total Butterfat Processed Used in Butter, Creameries, Mississippi, 1939-48.

Season	1939-41	1942-45	1946-48
		Percent	
Jan.-March	98	87	57
Apr.-June	97	89	73
July-Sept.	97	87	71
Oct.-Dec.	98	83	50
Year	97	87	66

Table 27. Percent of Annual Butterfat Purchases From Other Plants, Creameries, Mississippi, 1939-48.

Season	1939-41	1942-45	1946-48
		Percent	
Jan.-March	18	13	17
Apr.-June	26	25	34
July-Sept.	36	38	32
Oct.-Dec.	20	24	17
Year	100	100	100

Supplies of the Skim Portion of Whole Milk

Although creameries are dairy processing plants that are primarily processors of the butterfat part of whole milk and cream supplies, they made full use of the skim portion of milk and cream supplies in ice cream, whole milk for direct consumption, dried skim milk, and dried buttermilk. This was particularly true from 1946 through 1948 when important uses of milk supplies were for ice cream and whole milk for direct consumption. The use of the skim portion of whole milk and cream exceeded producer receipts during the entire period studied. This indicates that these plants are potential markets for greater supplies of both whole milk and cream during all seasons of the year.

Ice Cream Plants [5]

Although ice cream plants are not large receivers or users of producer supplies of whole milk or cream, they purchase from other plants, large quantities of butterfat in cream, condensed milk, and dry skim dairy products, as well as whole milk to make ice cream. Since these plants were primarily summer markets, they offered one possibility for meeting the problem of summer surpluses. As total production of milk in Mississippi increases, this market for milk during flush production periods, will become more and more important.

The following discussion is an attempt to present a picture of the supply and use situation of ice cream plants for a 5-year period, 1944 through 1948, and to evaluate the possibilities of these processing plants as markets for Mississippi producers, and for manufacturing plants with surplus supplies of butterfat in cream as well as in whole milk.

Location

The ice cream plants were near the larger consumption centers located throughout the state (Figure 4). These plants were more concerned with the availability of markets for their finished product than with a local supply of whole milk or butterfat cream.

Number of Plants and Annual Producer Supplies

Since only ice cream plants selling ice cream at wholesale are included in this discussion, only the larger plants are accounted for. There were 14 wholesale ice cream plants from 1944 through 1946, and 15 operated as processors and wholesalers of ice cream during 1947 and 1948. These plants received approximately 700 thousand pounds of whole milk from producers during 4 of the 5 years. In 1946, producers supplied ice cream plants with slightly over 1 million pounds (Table 28). These plants have been dependent more on receipts of cream than on receipts of whole milk, with dried and condensed skim products being used for a skim-equivalent requirement.

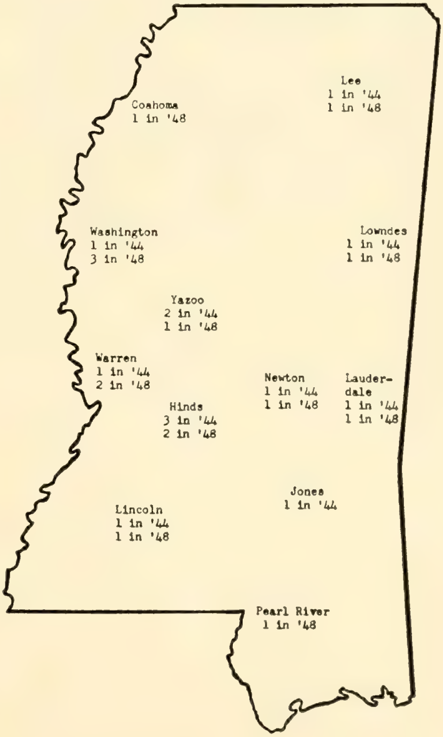

Figure 4. Location of plants in which the major use of milk supplies was in ice cream, Mississippi, 1944 and 1948.

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[5] Ice Cream Plants in this study were those selling ice cream wholesale and did not include retail counter freezers.

Supply and Use of Butterfat

Producer supplies of butterfat to ice cream plants varied from a high of approximately 435 thousand pounds in 1944 to a low of only 48 thousand pounds in 1947. These plants received approximately one-fourth million pounds of butterfat from producers during 1948 (Table 29).

Ice cream plants in Mississippi have had to purchase large quantities of butterfat from sources other than producers during each of the 5 years studied. These plants purchased about 600 thousand pounds of butterfat from other plants during 1944 and 1945, and almost one and one-half million pounds each year from 1946 through 1948.

Table 28. Number of Ice Cream Plants and Supplies of Whole Milk from Producers, Mississippi, 1944-48.

Year	Number of Plants	Receipts
		Cwt. of milk
1944	14	7,046
1945	14	6,737
1946	14	11,651
1947	15	7,913
1947	15	6,607

Ice cream plants made use of all their butterfat receipts in ice cream during 1944, 1947, and 1948. From 1 to 3 percent of total butterfat receipts was used in whole milk for direct consumption during 1945 and 1946 (Table 30).

Seasonal Purchasing of Butterfat from Other Plants

Ice cream consumption is highly seasonal, and it follows that the plants making large quantities of ice cream would purchase a large portion of their annual supply of butterfat during the summer months.

During the 5 years, 1944 through 1948, these plants purchased 65 to 70 percent of their supplemental supplies of butterfat from April through September (Table 31). This pattern of receipts and use fits in well with the summer surplus of both fluid milk plants and other manufacturing plants in the state, and offers opportunity for alleviating the problem of dis-

Table 29. Producers Supplies of Butterfat in Milk and Cream, and Total Use of Butterfat, Ice Cream Plants, Mississippi, 1944-48.

Year	Producer supply			Total use			
	Milk	Cream	Total	Direct consumption	Ice cream	Total	Deficit
	Cwt. of Butterfat				Cwt. of Butterfat		
1944	298	4,041	4,339	-	10,291	10,291	5,952
1945	406	3,589	3,995	191	10,211	10,402	6,407
1946	489	895	1,384	186	16,195	16,381	14,997
1947	277	199	476	----	15,131	15,131	14,656
1948	300	2,359	2,659	-- .	16,785	16,785	14,126

Table 30. Percent of Producer Supplies of Butterfat in Milk and Cream, and Use of Butterfat Expressed as a Percent of Producer Supplies, Ice Cream Plants, Mississippi, 1944-48.

Year	Producer supply			Total use			
	Milk	Cream	Total	Direct consumption	Ice cream	Total	Deficit
	Percent			Percent			
1944	7	93	100	--	237	237	137
1945	10	90	100	5	256	261	161
1946	35	65	100	13	1,170	1,183	1,083
1947	58	42	100	--	3,179	3,179	3,079
1948	11	89	100	--	631	631	531

Table 31. Percent of Annual Butterfat Purchased from Other Plants, Ice Cream Plants, Mississippi, 1944-48.

Season	1944-45	1946-48
Jan.-March	11	15
Apr.-June	31	30
July-Sept.	40	36
Oct.-Dec.	18	19
	—	—
Year	100	100

tributing this surplus supply of butterfat.

Supply and Use of the Skim Portion of Whole Milk

It was impossible to compute the supplies and use of the skim portion of whole milk and cream from ice cream plants and to present a picture of the supply situation. The method of computation followed was the same as the procedure outlined for computation of butterfat use in the previous section under condenseries. Conversion factors appear in Appendix Table 2. These plants have depended on other plants, largely out-of-area suppliers, to supply their needs for skim products for making ice cream. Ice cream plants use large quantities of dried or condensed skim milk at the present time, but the possibility of their using the skim portion of whole milk from local supplies should not be discounted.

These plants received from one to one and one-half million pounds of the skim portion of whole milk and cream from producers during each of the years studied, except 1947. During this year, producers supplied ice cream plants with only slightly over 680 thousand pounds of skim equivalent (Table 32).

Ice cream plants purchased from 5 to 6 million pounds of skim equivalent from sources other than producers during 1944 and 1945, and approximately 9 million pounds annually from 1946 through 1948. This was from 4 to 12 times the amount of producer supplies.

As in the use of butterfat portion of whole milk and cream, ice cream plants used practically all their skim equivalent receipts in ice cream (Table 33).

Table 32. Producer Supplies of the Skim Portion of Milk and Cream, and Total Use of Skim Product, Ice Cream Plants, Mississippi, 1944-48.

Year	Producer Supply			Total use			
	Milk	Cream	Total	Direct consumption	Ice cream	Total	Deficit
		Cwt.				Cwt.	
1944	6,309	7,516	13,725	....	67,058	67,058	53,333
1945	8,507	6,675	14,182	3,814	70,262	74,076	59,894
1946	11,162	1,664	12,826	4,016	98,736	102,752	89,926
1947	6,460	370	6,830	....	93,948	93,948	87,118
1948	6,746	4,386	11,132	....	104,437	104,378	93,246

Table 33. Percent of Producer Supplies of the Skim Portion of Milk and Cream Expressed as a Percent of Producer Supplies, Ice Cream Plants, Mississippi, 1944-48.

Year	Producer supply			Total Use			
	Milk	Cream	Total	Direct consumption	Ice cream	Total	Deficit
		Percent				Percent	
1944	46	54	100	..	489	489	389
1945	53	47	100	3	495	498	398
1946	87	13	100	3	770	773	673
1947	95	5	100	..	1,376	1,375	1,276
1948	61	39	100	..	938	938	838

Seasonal Purchasing of the Skim Portion of Whole Milk

The seasonal pattern of the purchase of skim equivalent from other plants follows very closely that of the purchase of the butterfat part of whole milk. Almost 70 percent of annual purchases by ice cream plants from sources other than producers, was made from April through September (Table 34). This use in ice cream plants fits in well with summer surpluses in fluid plants and will become even more important as new dairy producers develop and the supplies of milk for direct consumption increase.

Table 34. Percent of Annual Skim Equivalent Purchases from Other Plants, Ice Cream Plants, Mississippi, 1944-48.

Season	1944-45	1946-48
	Percent	
Jan.-March	11	15
Apr.-June	31	30
July-Sept.	38	36
Oct.-Dec.	20	19
	—	—
Year	100	100

All Dairy Manufacturing Plants

Producer Supplies of Whole Milk

Producers supplied Mississippi dairy manufacturing plants with approximately 20 percent less whole milk from 1946 through 1948 than in the peak year of 1945, and about 10 percent less than in 1944 (Table 35). A part of this decrease came from the shift of producers from the production of manufacturing milk to Grade A milk. Another factor causing this decrease in producer supplies has been the decreasing number of dairy cows on Mississippi farms.

No computation was made for all dairy manufacturing plants as far as seasonality of producer supplies of whole milk was concerned. The plants included in this study were located in the same general area of the state, and producer deliveries were affected by the same factors. From data previously presented, it was evident that producer supplies to all dairy manufacturing plants had become more concentrated in the spring and summer seasons.

Table 35. Supplies of Whole Milk from Producers, Dairy Manufacturing Plants, Mississippi, 1944-48.

Year	Receipts
	Cwt. of milk
1944	2,986,586
1945	3,354,079
1946	2,760,478
1947	2,643,732
1948	2,659,957

Supply and Use of Butterfat

Producers supplied dairy manufacturing plants in Mississippi with approximately 15 million pounds of butterfat in whole milk and cream in 1944, as compared to less than 13 million pounds in 1948. Producer supplies of butterfat reached a peak in 1945, when processing plants received over 16 million pounds of butterfat from this source (Table 36).

One of the significant changes in producer supplies has been the rapid decline in receipts of butterfat in cream. Cream supplies were only one-fourth as large in 1948 as in 1944, and accounted for approximately one and three-fourths million pounds of the increase in butterfat receipts.

With this decline in receipts of butterfat in cream came a decrease in the quantity of producer supplies of butterfat not processed by dairy manufacturing plants. According to calculations made in this study, dairy manufacturing plants had an annual surplus of producer receipts of butterfat of almost 700 thousand pounds in 1944 and over 2 million in 1945, as compared to less than 400 thousand pounds in 1948. Producer butterfat supplies were less than total use by manu-

Table 36. Total Producer Butterfat Supplies from Milk and Cream, and Total Use of Butterfat, Dairy Manufacturing Plants, Mississippi, 1944-48.

Year	Producer supply			Total use							
	Milk	Cream	Total	Direct consumption	Ice cream	Cheese	Butter	Condensed milk	Surplus	Deficit	Total use
	Cwt.			Cwt.							
1944	128,253	23,118	151,371	8,335	15,095	36,197	39,692	45,088	6,964	----	151,371
1945	144,209	20,942	165,151	4,212	15,857	40,715	29,733	50,112	24,522	----	165,151
1946	121,658	13,903	135,561	2,474	26,285	36,114	21,104	47,319	2,265	----	135,561
1947	117,782	8,291	126,073	1,590	21,208	37,058	23,968	43,185	----	936	126,073
1948	121,393	6,034	127,427	2,393	21,943	36,524	17,405	45,580	3,582	----	127,427

facturing plants in 1947. Producer cream supplies as well as butterfat in whole milk declined during this year.

The more significant changes in use were decreases in the proportion of total butterfat processed as butter, and in milk sold for direct consumption, and increases in the proportion of butterfat receipts utilized in ice cream, cheese, and condensed milk (Table 37). These latter products were relatively higher in prices during 1946 through 1948 as a result of increased consumer incomes, changes in price relationships among dairy products, and the stronger demand for these processed products after consumers became accustomed to substituting them for whole milk and other dairy products during the war.

Seasonal Use of Butterfat

Dairy manufacturing plants processed greater proportions of their producer supplies of butterfat during spring and summer months than during the fall and winter months (Table 38). This was brought about because of the influence of receipts and use of butterfat by condenseries and cheese plants, in which receipts of the skim portion of whole milk tended to regulate seasonal use of the fat portion of whole milk. The use of larger quantities of butterfat in ice cream during the summer months of 1946 through 1948 also affected the use pattern. From March through September during 1946 through 1948, dairy manufacturing plants in Mississippi processed from 95 to over 100 percent of their producer supplies of butterfat. In 1947 and 1948 producer supplies of butterfat from April through August were less than the amount used by all processing plants in the state. Manufacturing plants were able to obtain butterfat

Table 37. Portion of Producer Butterfat Supplies from Whole Milk and Cream, and Use of Butterfat Expressed as a Percent of Producer Supplies, Dairy Manufacturing Plants, Mississippi, 1944-48.

Year	Producer supply			Total use							
	Milk	Cream	Total	Direct consumption	Ice cream	Cheese	Butter	Condensed milk	Surplus	Deficit	Total use
	Percent			Percent							
1944	85	15	100	6	9	24	26	30	5	--	100
1945	87	13	100	3	9	25	18	30	15	--	100
1946	90	10	100	2	19	27	15	35	2	--	100
1947	93	7	100	1	17	29	19	34	--	1	101
1948	95	5	100	2	17	29	14	36	2	--	100

Table 38. Butterfat Processed by All Dairy Manufacturing Plants Expressed as a Percent of Producer Supplies, Mississippi, 1944-48.

Month	1944	1945	1946	1947	1948
		Percent			
January	90	76	93	95	84
February	94	74	97	96	90
March	94	83	97	96	100
April	98	91	99	101	103
May	96	88	97	106	95
June	96	87	97	106	100
July	95	85	100	102	101
August	97	86	100	104	101
September	97	86	99	100	97
October	97	82	98	100	91
November	93	86	98	87	94
December	89	81	95	88	93
Total	95	85	98	101	98

in whole milk from other plants and produced large quantities of dairy products during these months. Another factor causing this change was the increase in the proportion of butterfat supplies from whole milk.

Seasonal Use of Butterfat in Various Products

Those dairy products that were processed primarily from whole milk standardized at less or approximately the same butterfat content as when received from producers, accounted for uses of slightly larger proportions of butterfat receipts during the spring and summer months than during the fall and winter seasons. Condensed milk and cheese fell in this category (Appendix Tables 3 and 4).

Butterfat in whole milk sold for direct consumption was an exception to the above statement, since dairy manufacturing plants sold butterfat in this product almost altogether during the fall and winter months (Appendix Table 5).

With the exception of the fall of 1948, butter also made up a greater part of butterfat use during the flush production period than during the fall and winter (Appendix Table 6). This was brought about primarily by the purchasing of butterfat in cream from other plants during the season when supplies were more easily obtainable.

Ice cream accounted for greater proportions of butterfat use during the fall and winter months than during the spring and summer (Appendix Table 7). This was due to some extent to the surplus cream made available to ice cream plants by cheese plants and condenseries through standardizing their supplies to approximately 4 percent butterfat. Condenseries and cheese plants were almost entirely dependent on producer supplies during the period studied.

Seasonal Availability of Producer Butterfat Supplies for Sale

From 1944 through 1946, approximately 60 percent of the annual unused producer butterfat supplies of dairy manufacturing plants occurred during the 7 months March through September (Table 39). During 1947 and 1948, this pattern shifted and greater quantities of the unused annual total were present during the months of low receipts than during the flush production season. Several factors accounted for this change. Producer supplies of butterfat had decreased, with a large part of the decrease being in receipts of butterfat in cream. This meant that larger quantities of butterfat could be used by condenseries and cheese plants

Table 39. Percent of Annual Surplus Producer Supplies Available for Sale During Each Month, Dairy Manufacturing Plants, Mississippi, 1944-48.

Month	1944	1945	1946	1947	1948
		Percent			
January	11	8	16	10	17
February	7	9	8	11	11
March	9	8	10	12	--
April	5	6	6	--	--
May	11	10	17	--	17
June	9	10	19	--	--
July	12	12	--	--	--
August	6	11	--	--	--
September	5	8	4		10
October	4	8	5		24
November	9	5	4	38	11
December	12	5	11	29	10
Total	100	100	100	100	100

during the summer months. Also, during the summer months of 1947, butterfat processed into butter accounted for unusually large proportions of butterfat use. By 1947 and 1948 production of Grade A milk had expanded until fluid plants were using manufacturing plants as market outlets for surplus milk during the flush production months. The butterfat use picture changed in terms of producer supplies, since the manufacturing plants used more butterfat than their regular sources supplied.

Supplies of the Skim Portion of Whole Milk

When previous studies are compared to the information presented in the present one, it becomes evident that dairy manufacturing plants in Mississippi, particularly cheese plants and condenseries, are potential markets for large quantities of whole milk. In the study previously cited, it was brought out that plants operated at only 68 percent of capacity during the peak production month of 1944 and an average of only 48 percent for the year.

Since this time producer supplies have shown greater fluctuation and at the same time have decreased, so there is no reason to believe that dairy manufacturing plants operate at any greater extent of capacity at the present time. Another supporting factor for the above statement is that there were about as many plants in 1948 as in 1944, so that both total and average supplies per plant were less in 1948. Producer supplies of whole milk can increase considerably in the summer months and still be used, but the greatest need is for larger deliveries in the fall and winter months.

It is recognized that dairy processing plants as a group would need a market for surplus butterfat, if large increases in production of whole milk occurred and the trend toward use of greater quantities of the skim portion of whole milk continued. However, little difficulty need be anticipated on this matter because of the requirements of plants in adjoining states and of the possibility of a return to large-scale butter-making if large supplies of butterfat became available.

Additional research is needed to determine to what extent of capacity dairy manufacturing plants are operating at the present time, the additional costs incurred because of this pattern of operation, and the exact supply needs of these plants in view of markets for products processed by them.

Summary and Conclusions

Dairy manufacturing plants are the most important market outlets for milk produced in Mississippi. Condenseries, cheese plants, creameries, and ice cream plants have received more than one-half of all milk sold from farms in the state.

Most of the condenseries, cheese plants, and creameries were located in the same area, the northeast section of Mississippi. Location was influenced more by lack of competition from fluid plants at the time the manufacturing plants were established, than by climatic conditions, soil types, or systems of farming. However, population is the major factor influencing the location of ice cream plants. Supplies of whole milk from producers decreased for manufacturing plants as a whole from 1945 to 1948, from over 335 million pounds in the former year to almost 266 million pounds in the latter. This decline was absorbed by condenseries, cheese plants, and ice cream plants. Producer supplies of whole milk increased in creameries but did not increase enough to offset the decline in cream receipts. Whole milk receipts in condenseries fell from 189 million pounds in 1945 to 142 million pounds in 1948; cheese plants received 129 million pounds as compared to 105 million pounds; and ice cream plants receipts were 250 thousand pounds less. During this same period, producer supplies to creameries increased approximately 2 million pounds, from 16 million pounds in 1945 to 18 million in 1948.

A part of this decline in producer receipts was due to the expansion of large out-of-state fluid markets, and the resulting shifts of producers to Grade A production. Another factor was a decline in number of milk cows on Mississippi farms.

Producer supplies of whole milk were concentrated in the spring and summer months, and showed a tendency to become more seasonal in nature over the period studied. During this period, due to an increased demand for fluid products. a number of the larger producers whose production patterns were conducive to supplying milk for direct consumption, began producing for the fluid market. This situation tended to accentuate seasonality in production with the remaining producers supplying manufacturing plants. Then too, summer pasture improvements have been quite noticeable, thereby stimulating seasonal production further. High farm incomes have also made it possible for producers to pay less attention to dairy herds during the fall and winter seasons. There was a lack of variation during the war period from season to season in milk prices. This was brought about by the government price control agency.

From 1939 through 1941, manufacturing plants received approximately 55 percent of their total producer supplies during the 5 months, April through August, and about 70 percent from March through September. In 1946 and 1947, they received slightly over 60 percent in the 5-month period and almost 80 percent during the 7 flush production months. Since most dairy manufacturing plants are located in the same general area and are affected by the same supply conditions; there was little difference between types of plants as to either the pattern of or change in seasonality of producer receipts.

Producer butterfat supplies to dairy manufacturing plants declined almost 4 million pounds from 1945 to 1948. Appoximately 35 percent of this decline was in butterfat from cream. Butterfat supplies to condenseries decreased slightly less than 2 million pounds, while cheese plants and creameries received about 1 million pounds less from producers. Ice cream plants showed the remainder of the decrease, approximately 200 thousand pounds.

The more significant changes in butterfat use by dairy processing plants were declines in the proportion of total butterfat processed as butter, and increase in the proportion of total butterfat receipts utilized in cheese, ice cream, and condensed milk. Butter made up an average of 22 percent total butterfat use, expressed as a percent of producer supplies, during 1944 and 1945 as compared to an average of 16 percent in 1947 and 1948. Use of butterfat in cheese and condensed milk as a percent of total use increased approximately 5 percent each over this period, while use in ice cream accounted for 8 percent more of total use during the latter years. During 1944 and 1945, an average of 10 percent of producer butterfat supplies were not processed by dairy manufacturing plants, while in 1947 and 1948 almost all producer supplies were processed. Plants used 1 percent more butterfat than they received from producers in 1947 and had a surplus of only 2 percent in 1948. The smaller surplus was due primarily to receipts of larger proportion of butterfat in whole milk rather than in cream.

With the trend toward use of increasing quantities of the non-fat portion of whole milk and cream, supplies of butterfat in whole milk, rather than butterfat in cream, are most important to dairy manufacturing plants. These plants particularly need this increase during the fall and winter months, but can make full use of substantially greater supplies of whole milk even during the spring and summer. If large butterfat surpluses resulted, out-of-state markets could in all probability be found and large-scale butter-making would be encouraged by the available supplies.

Appendix

Table 1. Conversion Factors Used in Computing Butterfat Use from Products Manufactured.

Product*	Percent butterfat in product
Butter	80.0
Ice cream mix**	10.0
Cheddar cheese	33.0
Condensed whole milk	8.5
Evaporated whole milk	7.9
Condensed skim milk	.1
Evaporated skim milk	.1

*Butterfat in whole milk sold for direct consumption was taken from annual reports made by the dairy manufacturing plants.

**Ice cream was converted to ice cream mix by dividing quantities of ice cream by two.

Table 2. Conversion Factors Used in Computing Skim Equivalent Use in Ice Cream Plants.

Product	Percent skim equivalent in product
Ice cream	60.0
Direct Consumption	Actual data

Table 3. Portion of Total Butterfat, Used in Condensed Milk, Dairy Manufacturing Plants, Mississippi, 1944-48.

Month	1944	1945	1946	1947	1948
		Percent			
January	28	38	36	32	38
February	33	34	36	33	38
March	35	40	36	32	38
April	34	38	41	36	42
May	28	31	36	37	35
June	30	35	36	36	38
July	32	38	37	35	38
August	32	36	33	30	36
September	32	36	32	33	36
October	32	35	31	30	35
November	28	31	33	34	32
December	30	35	35	35	33
Year	31	36	35	34	37

Table 4 Portion of Total Butterfat Processed, Used in Cheese, Dairy Manufacturing Plants, Mississippi, 1944-48.

Month	1944	1945	1946	1947	1948
		Percent			
January	18	26	23	26	27
February	21	32	24	28	26
March	22	27	25	29	25
April	24	28	26	27	28
May	28	31	31	29	35
June	29	29	28	30	30
July	27	30	27	31	30
August	26	31	28	30	31
September	25	28	27	29	29
October	22	27	26	28	28
November	23	25	26	29	26
December	23	24	25	27	25
Year	25	29	27	29	29

Table 5. Portion of Total Butterfat Processed, Used in Whole Milk for Direct Consumption, Dairy Manufacturing Plants, Mississippi, 1944-48.

Month	1944	1945	1946	1947	1948
		Percent			
January	16	8	6	5	5
February	11	6	4	4	4
March	7	3	3	2	3
April	4	2	1	1	1
May	3	1	1	--	1
June	3	1	1	--	1
July	3	2	1	--	1
August	3	2	1	--	1
September	4	2	1	1	2
October	7	4	3	1	3
November	10	7	4	4	4
December	13	9	3	4	4
Year	6	3	2	1	2

Table 6. Portion of Total Butterfat Processed, Used in Butter, Dairy Manufacturing Plants, Mississippi, 1944-48.

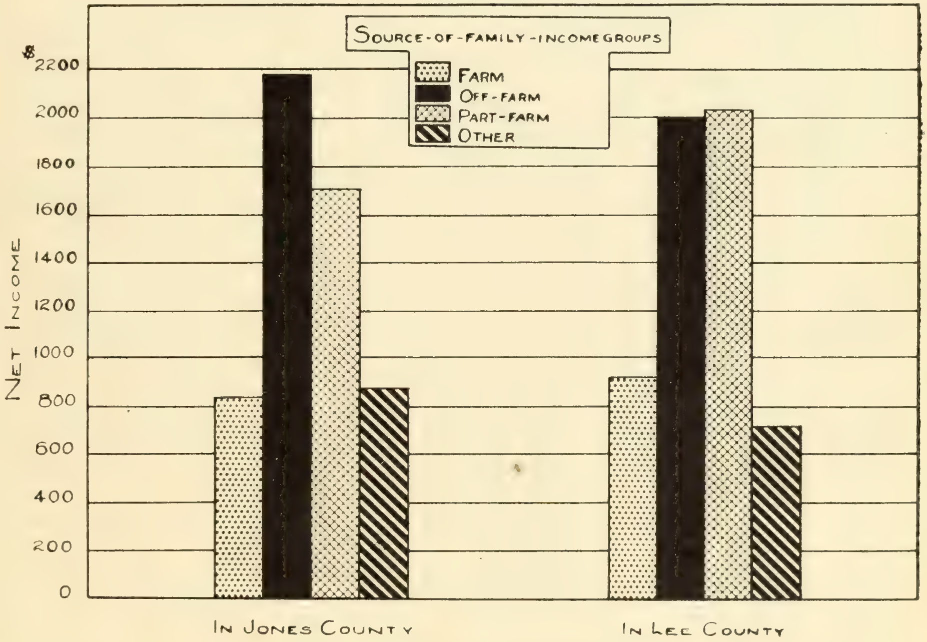
Month	1944	1945	1946	1947	1948
		Percent			
January	30	19	14	16	10
February	26	20	13	15	12
March	26	20	12	17	9
April	29	23	15	19	11
May	32	28	16	21	13
June	26	24	16	19	12
July	25	20	16	20	13
August	27	19	19	22	16
September	27	18	17	17	15
October	26	17	17	18	17
November	28	18	14	16	20
December	26	16	13	13	18
Year	27	21	16	19	14

Table 7. Portion of Total Butterfat Processed, Used in Ice Cream, Dairy Manufacturing Plants, Mississippi, 1944-48.

Month	1944	1945	1946	1947	1948
		Percent			
January	8	8	20	20	19
February	8	9	22	20	20
March	10	10	23	20	24
April	9	8	18	17	17
May	8	8	15	12	16
June	12	10	18	14	18
July	13	11	19	14	18
August	11	12	19	16	16
September	12	15	22	20	17
October	13	16	24	22	16
November	11	19	24	18	19
December	8	16	23	21	20
Year	10	11	20	17	18

BULLETIN 481 MARCH, 1951

THE RURAL FAMILY AND ITS SOURCE OF INCOME



Average net income of families in each of the four source-of-family-income groups, Jones and Lee Counties, Mississippi, 1945.

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
FRANK J. WELCH, Director
STATE COLLEGE MISSISSIPPI

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SIGNIFICANCE OF FINDINGS OF THIS STUDY

What significance do the findings in this study have for the low-income rural community? This study shows that building factories does not necessarily mean raising farm income. Gross value of sales from farm products by families in this study in the more highly industrialized Jones County were about the same as in the less industrialized Lee County. These values followed the same general patterns as had values for census farm families in the two counties (in 1919 and in 1929) when there was much less industrialization.

When cash expenditures made for food and housing were deducted from the net income of families in the Farm, Off-farm and Part-farm groups, residual income (or income left over) of families in the Off-farm and Part-farm groups was almost double that of families in the Farm group. Industrialization had not pulled the Farm group from its low socioeconomic plight.

Off-Farm Work Provided Better Living

This study showed that Off-farm work provided a much better living than the farm. Consequently, when families were classified by source of family income, those in the Off-farm and Part-farm groups had much higher incomes than those in the Farm group. They purchased more consumer goods and services during the report year, had better housing facilities and equipment, and participated somewhat more often in community organizations than did families in the Farm group. Families in the Part-farm group had expenditure patterns more like those of families in the Off-farm group, and home-production patterns more like families in the Farm group.

The important difference in the distribution of families by source of family income in the two counties was the difference in proportion of families in the Farm and Off-farm groups. In the more highly industrialized Jones County, relatively more of the families were classified in the Off-farm group, relatively fewer in the Farm group than in the less industrialized Lee County.

According to the 1945 Census of Agriculture, average acreage per farm of open land used for crops, plus open pastures, was in Jones County 30 acres, in Lee County 38 acres. Jones County in 1944 had over 35,000 more acres in crops and open pasture than it had in 1929. But the number of farm operators increased during this period so that the number of these acres per family per farm was only .5 acres more than in 1929. In Lee County there was no land to clear as in Jones. However, there was a decrease in number of farm operators in this period and hence an increase of 10 acres per family, in acreage in crops and open pastures. Evidently the cleared land in Jones County went to the man with off-farm work, who had the cash income to meet the mortgage payments, rather than to increase the land of families devoting themselves to farming.

More Research

From this study it would seem that a combination of off-farm work with farm operation within a family was most successful in larger families. In other words, smaller families who attempted to combine farm operation with off-farm employment were more likely to suffer a small net loss in farming. More protective foods in the form of home-produced milk, poultry, pork, tomatoes, however, may have more than compensated for the small net loss. Research is needed on how these two kinds of work might best be combined for the good of the family.

It is also needed on methods whereby local farmers may benefit from such industry. It is interesting to note that since this study was made, two distinct approaches to the solution to the problem of families in the low-income Farm group have been emphasized in the respective counties. The first, in Jones County, we shall call the commodity approach. In this approach competent, energetic men have been sent into rural areas to organize farm groups in furnishing specified vegetables to the market and to be processed. In Lee County the community approach has been emphasized. Here rural communities have been organized, and members of families are at work to improve not only their level of living, but that of every other family in their community. Business leaders in Tupelo, the county seat, cooperate and assist these rural communities. A re-survey of these two counties would no doubt yield valuable data on the effectiveness of these two approaches in improving manner of living of families in such areas.

THE RURAL FAMILY AND ITS SOURCE OF INCOME

By DOROTHY DICKINS[1]

During the last few years many industries have located in Mississippi. Some farm families have shifted in part, others altogether or almost altogether to off-farm work. Many of these families have continued to reside in rural areas of the state. The question has been asked concerning the manner of living of these rural families as compared with those who depend on the farm for livelihood: are there any differences in manner of living of families deriving incomes from different sources?

The purpose of this particular report was twofold. The first and main purpose was to compare the manner of living of rural families, who are classified into four groups according to the source from which they derived their family income: (1) from farm work; (2) from off-farm work; (3) from both farm and off-farm work; and (4) from other sources. (See definitions of the four groups, page 6.)

The other purpose was to study the distribution of the families classified by source of family income in two counties where type as well as degree of industrialization differed.

The data in this report were obtained in connection with a study of rural family living in two industrialized counties of Mississippi—Jones and Lee Counties. This study was made during 1946 by members in the Family Economics Division of the Bureau of Human Nutrition and Home Economics of the United States Department of Agriculture and in the Home Economics Department of the Mississippi Agricultural Experiment Station.

Industrialization In the Two Counties

Industrialization was much more advanced in Jones than in Lee County. According to the 1945 Agricultural Census, 23 per cent of the Jones County farm operators had worked 100 days or more off the farm during the past year, while only 4 per cent of the farm operators in Lee County had worked as many days off the farm during the period. At the time of the study one industrial plant of the 50 located in Laurel, the county seat of Jones County, employed as many workers as all industrial plants in Tupelo, the county seat of Lee County.

At this time the principal plants in Laurel were forestry-products-factories employing males, while in Tupelo most of the plants were garment factories employing women. It was estimated by the secretaries of Chambers of Commerce in these two cities that in Laurel 10 persons out of 100 and in Tupelo 75 persons out of 100 industrially employed were women.

The Families Selected

A representative sample of rural areas in Jones and Lee Counties was drawn by the statistician of the Family Economics Division of the Bureau of Human Nutrition and Home Economics. Two types of areas were drawn for each county. These were (1) village areas including incorporated or unincorporated towns of 100 to 2500 persons and other areas where the population density was at least 100 persons per square mile and (2) open country areas.[2]

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[1] The data presented in this report were collected by the Bureau of Human Nutrition and Home Economics in cooperation with the Department of Home Economics of the Mississippi Agricultural Experiment Station. Acknowledgment is made of assistance by the staff of the Family Economics Division, particularly Barbara B. Reagan, Evelyn Grossman, and Elizabeth Davenport in developing plans for tabulations and analyses.

[2] For further details regarding the sampling, type of schedule, field procedures and other methodology used in this survey, see Barbara B. Reagan and Evelyn Grossman, **Rural Levels of Living in Lee and Jones Counties, Mississippi, 1945, and a Comparison of Two Methods of Data Collection,** U. S. Dept. Agri., Agri. Info. Bul., in press.

According to the plan, the areas drawn would yield approximately 550 families per county, 400 farm operator and 150 non-operator families. The yield in both counties was, however, somewhat more than 400 farm operator families and somewhat less than 150 non-operator families. Data were obtained from a total of 578 families in Jones County and 613 families in Lee County.

In this study families included one-person units as well as units of two or more persons. The members of a family included those who were dependent upon a common income, shared expenses and usually shared the same table and lived at the same address. The test of a one-person family was keeping income and expenditures for living separated from those of relatives or others.[3]

Source of Family Income

Within these rural families were many combinations of work activities. Sometimes the head spent all his time on the farm, and his sons, wife, and/or daughters earned from non-farm work. Sometimes the head combined farm and off-farm work activities. Sometimes he worked full time off the farm, and his wife and children farmed. In some families work activities of all members were limited practically altogether to the farm; in other families, to off the farm. Some families lived on allotments, pensions, rentals, that is, from income other than work activities.

To compare manner of living of families with income derived from different sources, it was therefore necessary to set up definitions for sources of family income. Families in this report were classified into the following four groups according to source and amount of their family income during 1945:

Source-of-family-income-groups	Income from farm operation*		Income from Off-farm work
Farm	Gross cash income $100 or more	and	Less than $50 cash receipts
Off-farm	Gross cash income less than $100	and	$50 or more cash receipts
Part-farm	Gross cash income $100 or more	and	$50 or more cash receipts
Other	Gross cash income less than $100	and	Less than $50 cash receipts

*Operator's share of gross cash from income.

The average income from farm and non-farm sources of the families classified by source of family income is shown in Table 1. As will be noted, Off-farm and Other families in both counties averaged a net loss in farming because included in these groups were farm operator families whose gross cash income from farming was less than $100. Included were a number who suffered a net loss in farm operation. (See Table 5 in the Appendix for proportion of farm operators in these two groups.) Farm and Part-farm families in Jones County averaged $411 and $337, respectively, from farm operation; averages were for Farm and Part-farm families in Lee County, $755 and $519 respectively.

Families in the Other group derived practically all their cash income from sources other than from work activities, such as from dependency allotments, pensions, royalties. In both counties male heads in about one-third of the families classified in the Other group were World War II veterans.

Families classified in the Off-farm groups in Jones County averaged $2007 and those in Lee County $1829 from work off the farm. Work off the farm included all kinds of gainful work except farm operation. As is shown in Table 1, earnings from off-farm work for the Part-farm group were considerably less than for the Off-farm group.

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[3] The term "family" as used in this report corresponds to the term "consumer unit" used in the U. S. Department of Agriculture Information Bulletin based on this survey. For definitions of other terms used in this study see Reagan and Grossman, **op. cit.**

TABLE 1. Average net income derived from farm operation, from off-farm work and from other sources by families in each of the four source-of-family-income groups, Jones and Lee Counties, Mississippi, 1945.

How income derived and county	Source-of-family-income groups			
	Farm	Off-farm [1]	Part-farm	Other [1]
	Dollars	Dollars	Dollars	Dollars
Farm operation [2]				
Jones County	411	—71	337	—45
Lee County	755	—58	519	—19
Off-farm work				
Jones County	17	2007	1130	1
Lee County	3	1829	1337	2
Other income [3]				
Jones County	415	262	235	921
Lee County	164	229	179	739

[1] An average negative income from farm operation.

[2] Includes net farm income adjusted for inventory changes and depreciation on farm equipment and buildings.

[3] The presence of oil in Jones County accounted for the difference in amounts of other money income received by families in the two counties.

The classification by source of family income differs from classifications generally used in that it is based on amount and source of earnings of all members of the family, rather than of the family head. A family of a full-time farm operator whose wife worked in a garment plant would, for example, be classified in this study as a Part-farm family. It would seem that in comparing manner of living of families in rural industrial areas that a source-of-family-income classification such as the one used in this study is much more appropriate than a classification based on the census definition of a farm. Manner of family living is determined in large part by kind and amount of family income.

Differences In the Two Counties

The two questions which are to be discussed in this section are (1) whether distribution of families by source-of-family-income groups in the two counties, differing in intensity and type of industrialization, differed; (2) whether net income patterns of families as shown in the four source-of-family-income groups in the two counties were similar. Because of the method of sampling, data from the two counties in each of the four groups could not be combined. But if net income patterns of families in each of these groups in the two counties were similar, it was thought that conclusions concerning source of family income would be strengthened by showing data in the two counties separately.

Distribution of families in Farm, Off-farm, Part-farm and Other groups is dependent on type as well as extent of industrialization. In Jones County most of the industries employed men. This meant that many of the farm operators had shifted from the Farm to the Off-farm groups, either not farming at all, or on such a small scale that they were classified in the Off-farm group.

More of the wives in the Off-farm and Part-farm groups of Lee County had earnings from Off-farm work, as might be expected. The percentages of families for the Off-farm group with wives with such earnings were in Lee County 32, and in Jones 19. The percentages for the Part-farm group in Lee were 20 and in Jones 14.[4] That differences were not greater can be accounted for by the large amount of industrial work in Jones County. Even though the proportion of plants employing women was low, the actual number of women involved was large. Also, much industrialization brings increased opportunities in clerical services, domestic service, professional work and the like.

The percentage of families classified in each of the four groups in the two counties was:

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[4] A few female heads are included with wives.

	Source-of-family-income groups			
	Farm	Off-farm	Part-farm	Other
In Jones County	15	44	34	7
In Lee County	37	29	27	7

Fifteen per cent of the Jones County and 37 per cent of the Lee County families were classified in the Farm group, while the percentages in the Off-farm group in the two counties were 44 and 29 respectively. There was little difference in the percentages of families in the two counties classified in the Part-farm group.

In the highly industrialized Jones County, about eight out of every ten families were classified either in the Off-farm or Part-farm groups. In the less industrialized Lee County, about five out of every ten families were classified either in the Off-farm or Part-farm groups.

The other question to be discussed in this section is whether net income patterns of families as shown in the four source-of-family-income groups in the two counties were similar. (Net income as here defined includes net adjusted farm income plus net non-farm earned income plus other money income.)

As is shown in both counties, averages were more than two times as high for families in the Off-farm and Part-farm groups as for families in the Farm and Other groups (see front cover). Furthermore, distribution of families in the two counties in each of the four source-of-family-income groups by net income was similar. About two-thirds of the families in both counties classified in the Farm group, nearly one-fifth classified in the Off-farm group, and almost one-third in the Part-farm group had incomes of less than $1000. (See Table 4 in the Appendix). More than one-half of the families classified in the Other group in both counties had net incomes of less than $1000, but the percentage was greater in Lee County, where income was not received from royalties.

Because families in the Part-farm group were large, when net income is figured on the per capita basis this group of families does not show up as well as when comparisons are made on the family basis. Average per capita income of families in the four groups and two counties was:

	Source-of-family-income groups			
	Farm	Off-farm	Part-farm	Other
In Jones County	$227	$583	$330	$373
In Lee County	247	585	446	293

As is shown, per capita income patterns of families in the two counties were similar except for families in the Other group. This group constituted only 7 per cent of the families included in the study in both counties. It was made up of families living principally on unearned income. In both counties per capita income was highest in the Off-farm group and lowest in the Farm group and intermediate in the Part-farm group. The higher average income for the Part-farm group in Lee County can be accounted for by large incomes of several families in this group.

It might be expected that net income of families in the Jones County Farm group would be greater than that of the families in the similar group in Lee County, since Jones County was more industrialized. Greater industrialization means greater money income and more markets for farm products. Local growers have an advantage over other growers in being nearer this market. But families in the Jones County Farm group did not have higher incomes than families in the Lee County Farm group. In fact, if it had not been for the royalties received, net incomes of families in the Jones County Farm group would have been considerably less.

Following are average farm receipts, average farm disbursements, and proportion of farm receipts from cotton and cotton seed of Jones and Lee County families, classified in the Farm group:

	Average farm receipts	Average farm disbursements	Percentage of receipts from cotton and cotton seed
In Jones County	$1083	$650	24
In Lee County	1140	342	64

Cotton was relatively unimportant in Jones County, because of the prevalence of boll weevils in this section of the state. Sweet potatoes and vegetables were the main cash crops in Jones County. These were shipped, sold to local canning plants, and/or sold to local retailers and residents.

As is shown, farm receipts of families in the Farm groups in both counties were about the same, those in Jones County averaging only slightly less than in Lee County. It is interesting to note that at a time when there was less industrialization, that is, in 1929 and 1919, farm receipts averaged in the former period $645 per farm family in Jones County and $735 in Lee County, and in the latter period $849 in Jones County and $1,155 in Lee County. In other words, greater industrialization does not seem to have changed the situation of the farm family in Jones County.[5]

As will be noted from the foregoing summary, farm disbursements were greater for families in Jones than in Lee County. Truck farming is more expensive than cotton farming. Then, too, the soil of Jones County is not as fertile as that of Lee County and land has to be more heavily fertilized in Jones County.

A significant finding from this study is the similarity in income patterns of rural families in the four source-of-family-income groups in two counties where intensity and type of industrialization differ. In both counties, families in the Farm group have much lower income, those in the Off-farm group higher income. The differences found in the two counties are for the most part insignificant. It is the purpose of the study to compare manner of living of these four groups of families.

The manner of living of rural families with income from different sources is an important problem to the state and its people. It is especially important now that Mississippi is rapidly becoming more industrialized that such industries serve in the best possible way all groups of families. This study furnishes some facts and figures on which such planning can be based.

Differences In Families In the Four Source-of-Family-Income Groups

It is a fact that the average net incomes of families in the Off-farm and Part-farm groups were considerably higher than the average net incomes of families in the Farm and Other groups. But some rural families produce large quantities of food, others produce little. Some rural families are provided a family dwelling, others must rent their dwelling. To compare the manner of living of the four groups, it is therefore necessary to know the residual income, or the income left after food and housing expenses are deducted.

Their Residual Income:

The average residual income of families in the four source-of-family-income groups in the two counties was as follows:

	Source-of-family-income groups			
	Farm	Off-farm	Part-farm	Other
In Jones County	$600	$1421	$1154	$509
In Lee County	687	1344	1622	440

As may be noted from the foregoing summary, residual incomes, too, of families in the Off-farm and Part-farm groups were considerably higher than residual incomes of families in the Farm and Other groups. In other words, families in the Farm and Other groups had about one-half the amount that families in the Off-farm and Part-farm groups, after expenses for food and housing were deducted.

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[5] One possibility examined was that greater industrialization in Jones County had drained more of the younger workers and workers with more schooling off the farm. Eighteen percent of the Lee County family heads and four percent of the Jones County family heads classified in the Farm group were under 35 years of age. (See Table 23 in the Appendix for percentage of family heads in each source-of-family-income group who were under 45 years of age.) The little difference in schooling found in family heads in the Farm group of the two counties can probably be accounted for by difference in race-tenure patterns. (See Table 28 in Appendix for schooling of male heads and wives in the four source-of-family-income groups.)

Since income of families in the four groups differed, it is necessary to classify by net income classes before comparisons in manner of living are made. Families in the Other group are not included in these comparisons since there were too few families in this group to divide into income classes.

Shown below are expenditures for family living categories other than food and housing by families with net incomes of $0-$999 and of $1000 and over in the Farm, Off-farm, and Part-farm groups:[6]

	Source-of-family-income groups		
	Farm	Off-farm	Part-farm
Net income $0-$999			
In Jones County	$397	$408	$459
In Lee County	356	380	434
Net income $1000 and over			
In Jones County	722	1021	960
In Lee County	665	1045	984

Families with net incomes of $0-$999 in each of the three source-of-family-income groups spent about the same average amount for family living items other than for food and housing. At this low income level, expenditures for family living were probably at the minimum for all groups. (See Table 10 in the Appendix).

But at the $1000 and over net income level, expenditures for these items by families in the Farm group were considerably less than by families in the Off-farm and Part-farm groups, even though average residual income was about the same. (See Tables 9 and 11 in the Appendix). These findings are in agreement with other studies, i.e., that farm families spend relatively less for family living.

Changes in assets and liabilities: The difference between the income of a family over a period and its outlays for current living, gifts, direct taxes, and occupational expenses is accounted for by changes in assets and liabilities. Each family in the study was asked to report the increases or decreases in the various forms of assets and liabilities that had taken place during 1945. Only changes resulting from money transactions were regarded. Increases and decreases in the market value of real estate, securities, and other property held by the family, and changes in inventories of livestock and other farm products or in other business inventories were not considered.

Assets included bank accounts and money on hand, investments in business and real estate, government bonds and other securities, insurance, improvements on owned dwellings, or other real estate and loans made to others. Liabilities included amounts payable on mortgages, notes due, balance due on installment purchases, and other bills, rent, and taxes due.

For each family the algebraic sum of all the changes was calculated, giving the net change in all assets and liabilities during the year 1945. A positive change, which appears when the total increases in assets and total decreases in liabilities exceeded the total decreases in assets and increases in liabilities was designated a net surplus. A negative change in all assets and liabilities was called a net deficit.

Families in the three source-of-family-income groups presented similar change in assets and liabilities patterns. Those in the $0-$999-net-income-class in each of the three source-of-family-income groups showed an average deficit. About 60 per cent of the families in every group had net deficits for the report year.

Families with $1000 and over net incomes in the three groups showed an average surplus. About 80 per cent of the families in each group had net surpluses but there was a tendency for the percentage of families with a net surplus to be somewhat greater in the Farm group.

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[6] Residual income differs from family living expenditures other than food and housing by the amount of net change in assets and liabilities and by taxes paid, gifts, and community welfare.

Here the question might well be asked concerning ways families in the three groups increased assets or decreased liabilities. Relatively more Farm and Part-farm families in both income classes made mortgage payments than did Off-farm families, but relatively more Off-farm families made expenditures for home improvements and paid on life insurance premiums. The proportion of families in the Part-farm group making home improvements and having expenditures for life insurance premiums was greater, however, than in the Farm group but less than in the Off-farm group. (See Table 12 in the Appendix.)

Food: Families in all four source-of-family-income groups had food obtained by direct expense and food obtained without direct expense. Food obtained by direct expense included food purchased for meals served at home, meals away from home, and between-meal snacks. Food obtained without direct expense was, for the most part, produced by the family for home consumption. The amount of food secured as gifts, in pay for services or as relief was negligible. Insofar as available, average prices received by Mississippi farmers in 1945 were used in evaluating home-produced food. Where these prices were not available for Mississippi, what was considered the next best price was used; as for example, a farm price for a substitute product, a price for a neighboring state, a regional price. The same prices were used in evaluating home-produced foods for all families in both counties.

Average expenditures for food purchased for meals served at home, meals served away from home, and between-

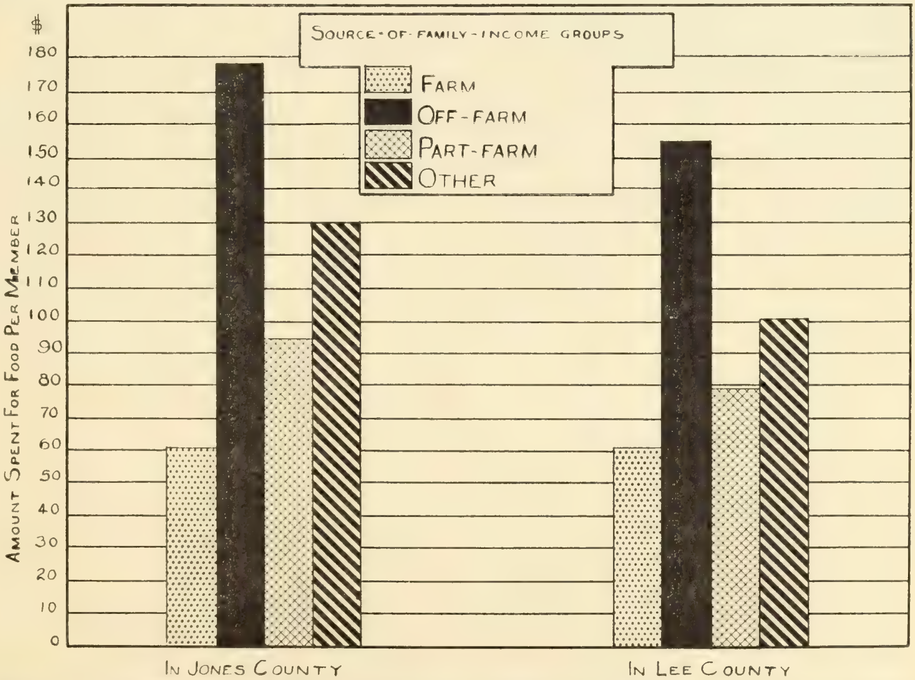

Figure 1. Average amount spent for food per member by families in each of the four source-of-income groups, Jones and Lee Counties, Mississippi, 1945.

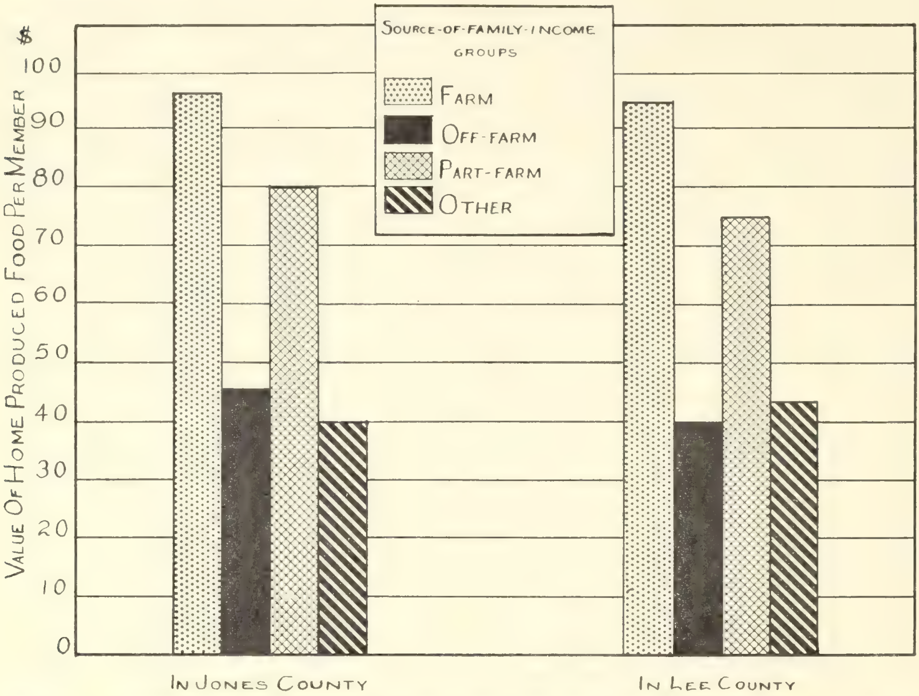

Figure 2. Average money value of home-produced food per member by families in each of the four source-of-family-income groups, Jones and Lee Counties, Mississippi, 1945.

meal snacks by families in the four groups is shown in Table 13 of the Appendix. Average per capita expenditures in each of the four groups at the two income levels were as follows:

	Source-of-family-income groups		
	Farm	Off-farm	Part-farm
Net income $0-$999			
In Jones County	$57	$143	$66
In Lee County	59	92	52
Net income $1000 and over			
In Jones County	71	183	106
In Lee County	65	163	89

At both income levels, families in the Off-farm group spent most for food and families in the Farm group least. At the lower income level expenditures for food per member were about the same in families of the Part-farm as in families of the Farm group. But at the higher income level Part-farm families spent considerably more than Farm families. Families of the Part-farm group were largest[7] and this fact probably accounts for their low expenditures for food at the $0-$999 income level.

Expenditures for food away from home were more than twice as important in the food budgets of Off-farm and Part-farm families as in those of Farm and Other families, taking a little more than 20 per cent of the budget of the former groups and a little less than 10 per cent for the latter groups.

Figures 1 and 2 show differences in food expenditures and production for home use patterns of families in the four source-of-family-income groups.

Table 15 in the Appendix shows the money value of home-produced food used by families in the four source-of-family-income groups. Average money value per capita for the four groups at the two income levels was:

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[7] Family size is in year equivalent persons and was obtained by adding together the number of weeks during 1945 each member was in the economic family and dividing this total by 52.

	Source-of-family-income groups		
	Farm	Off-farm	Part-farm
Net income $0-$999			
In Jones County	$95	$62	$64
In Lee County	92	40	65
Net income $1000 and over			
In Jones County	108	44	88
In Lee County	88	39	71

When families of all incomes are averaged, there is little difference in per capita money values of home-produced food used in the Farm and Part-farm groups (Figure 2). However, the preceding summary shows differences are greater at $0-$999 than at $1000 and over levels.

Money values of the various types of home-produced food used by Farm, Off-farm, and Part-farm families differed more than did total money values of home-produced food used. There was more difference in money values of meats, of potatoes, and of cereal and syrups used than of poultry and eggs. Thus, for example, average money values per family in the Jones County $0-$999 income class were for meat, game, and fish in the Farm group—$43, in the Off-Farm group—$28, for poultry and eggs in the Farm group—$51, in the Off-farm group—$41; for potatoes in the Farm group—$36, in the Off-farm group—$10; and for cereal and syrups in the Farm group—$22, and in the Off-farm group—$6. Money values of home-produced food used by the Part-farm group of families resembled more closely those of the Farm than of the Off-farm group. (See Table 16 in the Appendix.)

In Table 17 in the Appendix, the average amount per capita of certain specified home-produced food used is shown. Amounts used were almost invariably greater by the Farm group and less by the Off-farm group.

Shown below is the percentage of families in the four source-of-family-income groups who used home-produced milk during 1945:

	Source-of-family-income groups			
	Farm	Off-farm	Part-farm	Other
In Jones County	91	46	90	51
In Lee County	94	40	91	41

Most Farm and Part-farm families had some home-produced milk. The somewhat higher percentage of Jones than Lee County families using home-produced milk in the Off-farm and Other groups can probably be accounted for by the greater proportion of farm operators in the Jones than in the Lee County sample in these two groups.

There were variations in amounts of home-produced foods used in the two counties, but these variations were not as important as variations in the source-of-family-income groups. (See Tables 16 and 17 in the Appendix.) Variations in the two counties could usually be accounted for by differences in farm-tenancy patterns, in feed production, and in the sale of food products. In previous studies it was found that "Greatest food consumption was not always by families with greatest production, though families raising and selling large quantities of food consumed more of that food than did families who did not produce it or produced it in limited amount."[8]

Housing, Household Operation, and Furniture and Equipment: Since most of the families in the study were farm operators (all families in the Farm and Part-farm groups and about one-half of the families in the Off-farm and Other groups), home ownership was closely related to farm tenure patterns in the area rather than to source of family income. (See Table 5 in the Appendix for proportion of families in each source-of-family-income group who were farm owner-operators and Table 6 for proportion who were home owners.)

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[8] "A Study of Food Habits of People in two Contrasting Areas of Mississippi" and "A Nutrition Investigation of Negro Tenants in the Yazoo-Mississippi Delta," Dorothy Dickins, Mississippi Agricultural Experiment Station, Bulletins 245 and 254, November, 1927 and August, 1928. Homemakers in this study cooperated by estimating kinds and amounts of foods used during the week preceding the interview. An analysis of the diets of the families, however, is not included in this particular phase of the study, but is included in the report by Reagan and Grossman, **op. cit.** In this study it was found that small scale farm-operator families with off-farm earnings had the best diets. These would include most of the families classified in this report as Part-farm and many classified as Off-farm.

Average number of rooms in houses of families reporting was likewise related to home ownership and was:

	Source-of-family-income groups			
	Farm	Off-farm	Part-farm	Other
In Jones County	5.1	4.6	5.2	4.1
In Lee County	4.0	4.5	4.6	3.6

Where home ownership was greatest (Farm and Part-farm groups in Jones County), average size of family dwelling was greatest. Where ownership was least (Farm and Other groups in Lee County), average size of family dwelling was least.

But housing facilities and equipment which are becoming increasingly important for comfortable and satisfactory family living and source of family income were closely related as is shown in Figure 3. Families in the Off-farm group had nearly two times as many of the specified housing facilities and household equipment per family as families in the Farm group. Items included were running water, kitchen sink, tub and/or shower, flush toilet, mechanical refrigerator, power washing machine, self-heating iron, pressure cooker, sewing machine and radio.

At the $0-$999 income level very few of the housing facilities and household equipment were owned by families in any source-of-family-income group. Differences in average number owned are not significant. The fact that 67 per cent of the Lee County Farm group were farm tenants probably accounts for the slightly lower average number owned in this group.

Families with $1000 and over net incomes in all three source-of-family-income groups owned more of the specified housing facilities and equipment as is shown:

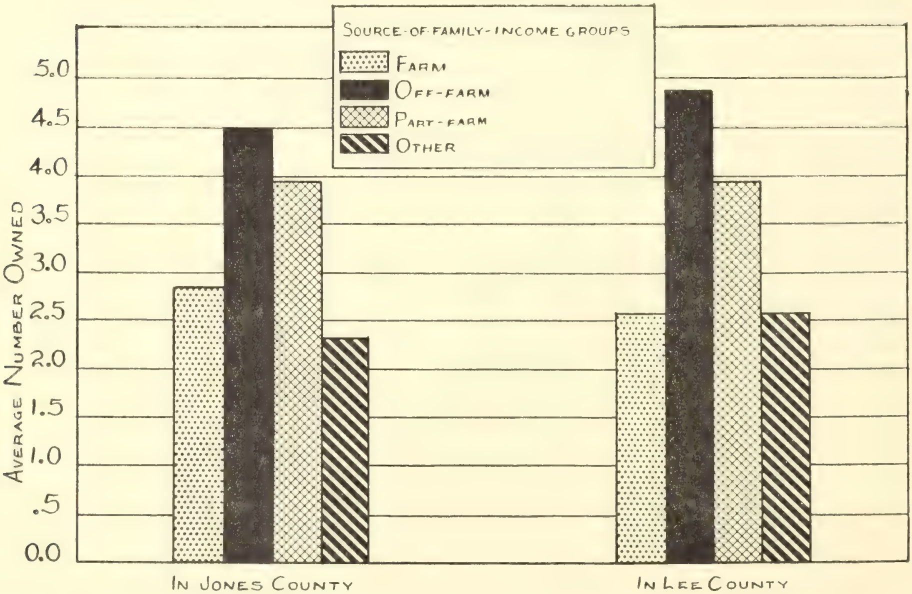

Figure 3. Average number of specified housing facilities and household equipment, owned by families in each of the four source-of-family-income groups, Jones and Lee Counties, Mississippi, 1945.

	Source-of-family-income groups		
	Farm	Off-farm	Part-farm
Net income $0-$999			
In Jones County	2.8	2.3	2.5
In Lee County	1.9	2.7	2.7
Net income $1000 and over			
In Jones County	3.4	5.0	4.7
In Lee County	3.9	5.3	4.2

At the higher income level, families in the Off-farm group owned more of the specified housing facilities and equipment than did those in the Farm group. As would be expected, differences in the source-of-family-income groups were greater for some items than others. There was, for example, more difference in percentage of families in the Farm and Off-farm groups having running water than in the percentage having radios in usable condition as is shown:

	Farm group	Off-farm group
Running water		
In Jones County	14	49
In Lee County	15	53
Radio in usable condition		
In Jones County	56	79
In Lee County	60	86

The most common of the specified equipment owned in all source-of-family-income groups were a sewing machine, a self-heating iron, and a radio. Relatively more families in the Off-farm group owned a mechanical refrigerator and a power washer; relatively fewer, a pressure cooker.

Information was not only secured concerning housing possessions but also concerning housing goods and services obtained by purchase and production. Like food, housing is partly purchased, partly furnished by the farm. The family dwelling is part of the farm. It is impossible to set out the part of the taxes or of the interest or the part of the rent which is for the farm and the part which is for the family dwelling. Also, some farm families secure their fuel in part or altogether from the farm. For these reasons, farm operator families would have less housing expense than non-operator families, at least for housing and household operation. The farm operator, like the non-operator, must purchase his furniture and equipment.

The average amount spent by families with net incomes of $0-$999 and of $1000 and over in the Farm, Off-farm, and Part-farm groups for housing, household operation and furniture and household equipment was:

	Source-of-family-income groups		
	Farm	Off-farm	Part-farm
Net income $0-$999			
In Jones County	$101	$153	$129
In Lee County	109	160	119
Net income $1000 and over			
In Jones County	145	367	292
In Lee County	202	412	326

Housing expenditures, like food expenditures, were lowest in both counties for the farm group and highest for the Off-farm group and intermediate for the Part-farm group.

The value of farm-furnished fuel was, as would be expected, greater for the Farm and Part-farm groups. It was:

	Source-of-family-income groups			
	Farm	Off-farm	Part-farm	Other
In Jones County	$67	$25	$67	$11
In Lee County	31	7	24	7

There were several factors which might account for differences in fuel furnished by the farm in the two counties. One of them was that low electricity rates of the T. V. A. in Lee County and the presence of a plentiful supply of pine wood in Jones County, which wood makes excellent fuel. Then, too, climate is milder in Jones County and families can get by with wood as their only fuel better than in Lee County where temperatures get lower.

Health: The families in this study were asked how many members 14 years and over and how many members under 14 years received paid health services once or more during 1945.

The following percentages were reported as having had expenses for a physician's care:

	Source-of-family-income groups		
	Farm	Off-farm	Part-farm
Persons 14 years and over			
In Jones County	50	45	57
In Lee County	68	44	52
Persons under 14 years			
In Jones County	41	43	43
In Lee County	53	55	56

As is shown in the summary above, the proportion of persons 14 years and over who had expenses for a physician's care was somewhat lower among families of the Off-farm group than among families of the Farm and Part-farm groups. But families of the Off-farm group were younger; that is, had more youthful family heads. (See Table 23 in the Appendix.) The proportion of persons under 14 years who had physician's care expenses was about the same in all three groups.

It would seem from Table 2 that members in the Farm group consult the dentist only when absolutely necessary, since percentage having had dental care in both age groups was not higher for the $1000 and over net income class. This was not true for members in the Off-farm and Part-farm groups, where percentages with dental care expenditures were greater among families of higher income, except for persons under 14 years in the Part-farm group of Lee County.

Data were also obtained concerning number of persons receiving free health services. These services were for the most part doctor's care, care of county nurse and/or county health officer. Three per cent of the family members in Jones County and two per cent in Lee County had free physician's care. The percentage of members with free care was the same for Farm, Part-farm and Off-farm families in Jones County, but in Lee County the percentage with free physician's care was greater in the Off-farm and Part-farm groups than in the Farm groups. It may be that in this study, as in other studies of this kind, there was a tendency to under-report free medical care. Tables 10 and 11 in the Appendix give average expenditures for health of families by source-of-family-income and net income class.

Clothing and Personal Care: Clothing and personal care expenditures included expenditures for purchases, dry cleaning, and other up-keep of all types of wearing apparel and expenditures for service, toilet articles and preparations. These expenditures were second in importance in all source of income groups. They were exceeded in amount by one other kind only, that is, by food.

Clothing and personal care, like food, is consumed individually. Therefore, it is important in comparing families in the different groups to take into consideration differences in family size. Shown on page 17 are average expenditures for clothing and personal care,

Table 2. Percentage of persons 14 years and over and under 14 years in families in each of the three source-of-family-income groups who had expenditures for a dentist's care, classified by net income, Jones and Lee Counties, Mississippi, 1945.

Person, net income class and county	Source-of-family-income-groups		
	Farm	Off-farm	Part-farm
	Percent	Percent	Percent
Persons 14 years and over			
$0-$999			
Jones County	18	18	26
Lee County	17	10	14
$1000 and over			
Jones County	13	25	39
Lee County	13	28	46
Persons under 14 years			
$0-$999			
Jones County	13	3	12
Lee County	15	0	4
$1000 and over			
Jones County	10	19	33
Lee County	9	13	4

per member of families in the Farm, Off-farm, and Part-farm groups:

	Source-of-family-income groups		
	Farm	Off-farm	Part-farm
Net incomes $0-$999			
In Jones County	$33	$43	$33
In Lee County	36	54	45
Net incomes $1000 and over			
In Jones County	63	78	77
In Lee County	68	109	88

At both levels of income, families in the Off-farm group spent most for clothing and personal care per member and families in the Farm group least, with one exception. Farm families with net incomes of $0-$999 in Jones County spent the same amount per capita as Part-farm families, i. e., $33.

Table 3 shows the average amount spent for clothing by male heads and wives in families of the Farm, Off-farm, and Part-farm groups at the two income levels. Averages for both male heads and wives in the Farm group were almost always lowest; for those in the Off-farm group, highest. However, differences were more marked at high than at low income levels, and more marked for wives than for male heads. In both counties, wives in the Off-farm group of families with net incomes of $1000 and over spent considerably more for clothing than wives in the other two groups.

Since clothing purchased during one year might not be representative of the type of wardrobe family members had, additional clothing data were secured. These included information concerning number of wool suits, overcoats, and leather or wool jackets owned by male heads; and of winter coats, spring coats, and felt hats owned by wives. (See Tables 24 and 25 in the Appendix.) The two garments in which there was greatest difference in average number owned were wool suits and spring coats. Male heads and wives in families of the Off-farm and Part-farm groups had more of these garments in their wardrobes.

Community Participation: In comparing manner of living of families, another consideration is community participation. In Figure 4 is presented the average community participation score of the male heads and wives in each of the four source-of-family-income groups. The score is based on attendance at meetings and social affairs of (1) the church, (2) farm organizations, (3) chambers of commerce, business or professional clubs, labor organizations, (4) public school, (5) social, civic, literary clubs and organizations during April and May, 1946, a period just preceding schedule taking.[9]

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[9] Average community participation score is the sum of the percents of male heads or of wives having attended one or more meetings of the five general types.

Table 3. Average amount spent for clothing by male heads and wives in families in each of the three source-of-family-income groups classified by net income, Jones and Lee Counties, Mississippi, 1945.

Member, net income class and county	Source-of-family-income-groups		
	Farm	Off-farm	Part-farm
	Dollars	Dollars	Dollars
Male heads			
$0-$999			
In Jones County	31	45	32
In Lee County	40	42	45
$1000 and over			
In Jones County	60	69	66
In Lee County	54	93	75
Wives [1]			
$0-$999			
In Jones County	29	47	36
In Lee County	32	30	37
$1000 and over			
In Jones County	57	80	57
In Lee County	61	104	65

[1] A few female heads were included with wives.

The pattern of participation of the four groups is shown in Figure 4. As will be noted, participation ratings are higher for both male heads and wives in families in the Part-farm group, and lowest in families of the Other group, or the group depending in the main on unearned income.

Attendance at church meetings and church social affairs accounted for the larger part of the participation score of these persons in all source-of-family-income groups. (See Tables 26 and 27 in the Appendix.) Attendance at school functions was next in importance. Relatively few of these men and women had attended meetings of other kinds during the report period. It is interesting to note that a larger proportion of those in the Part-farm group had attended one or more farm meetings than those in the Farm group.

Possible factors to account for greater participation of the men and women in the families of the Part-farm group would be larger incomes, more schooling, more facilities for getting to these meetings. It has already been shown that net income per member of families in the Part-farm group was less than

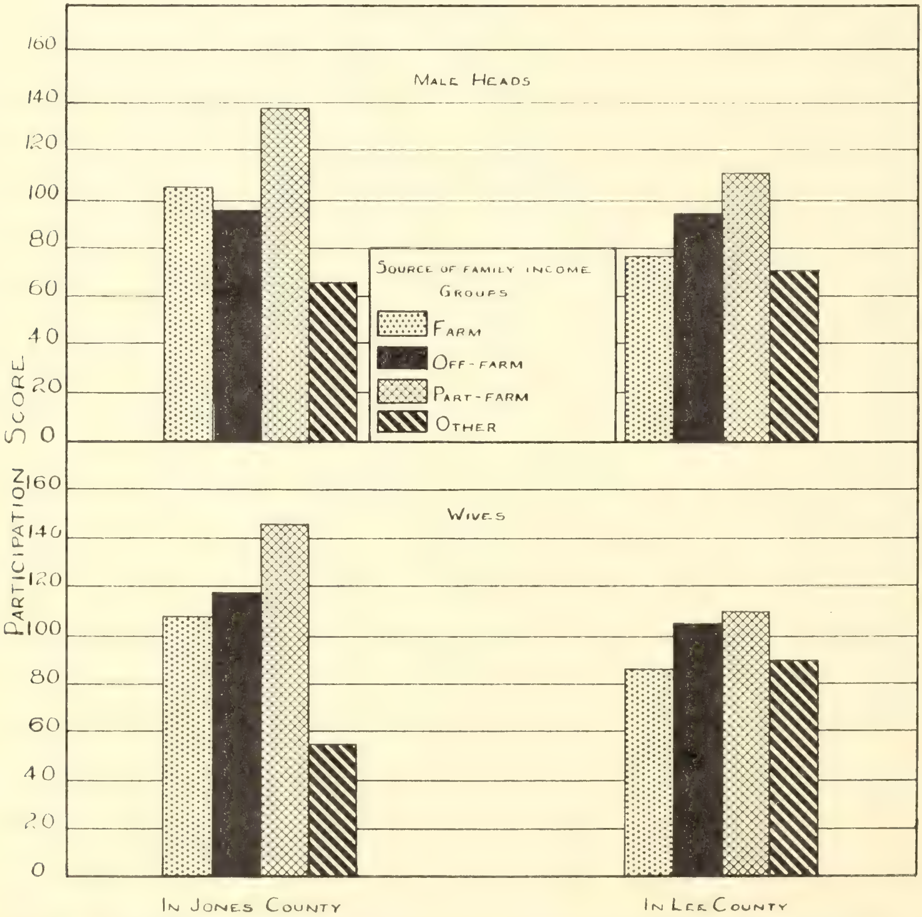

Figure 4. Community participation scores of male heads and wives in families in each of the four source-of-family-income groups, Jones and Lee Counties, Mississippi, during April and May, 1946.

that of families in the Off-farm group, whose members participated in community activities less. Table 28 in the Appendix gives information on proportion of male heads and wives who had completed nine or more grades in school in each of the four source-of-family-income groups. It is shown that male heads and wives in families of the Off-farm group had as much if not more schooling as did those in families of the Part-farm group.[10]

The percentages of families in the four source-of-family-income groups who owned one or more automobiles at the time of the study were as follows:

	Source-of-family-income groups			
	Farm	Off-farm	Part-farm	Other
In Jones County	32	46	56	9
In Lee County	33	43	53	10

This summary suggests that male heads and wives in the Part-farm groups may have had better facilities for getting to meetings. On the other hand, maybe these men and women, because they wanted to participate in community activities, made greater efforts to have a means of getting to meetings.

Summary

In this report are included family living data obtained for the year 1945 from 578 rural families in Jones County and 613 in Lee County, Mississippi. In both counties, rural families were shifting from farming into industrial work, but the shift was much more pronounced in Jones County, where there were about 50 industrial plants in the county seat.

It was the purpose of this study to compare manner of living of rural families according to their source of family income. The families were classified into the following four source-of-family-income groups: (1) Farm, (2) Off-farm, (3) Part-farm, and (4) Other. The classification by source of family income differs from classifications generally used in that it is based on amount and source of earnings of all members of the family, rather than of the family head.

In the highly industrialized county (Jones), in which most industrial workers were male, 44 per cent of the rural families were classified in the Off-farm group and 15 per cent in the Farm group. In the less industrialized Lee County, where most industrial workers were females, 29 per cent of the rural families were classified in the Off-farm group and 37 per cent in the Farm group. The proportion of families classified in the Part-farm and Other groups in the two counties was about the same.

Kind, as well as degree, of industrialization was responsible for the distribution of families according to source of family income. In Jones County, where most plants employed men, more farm families had given up farm operation, or farmed on small scale, generally at a small net loss. In Lee County, where relatively more plants employed women, it was expected that more families would be classified in the Part-farm group than in Jones County. That the distribution of families in the Part-farm groups did not follow the expected pattern can be accounted for by the fact that even though the proportion of industrial workers in Jones County who were women was low, the absolute number was not small. Also, industrial employment for men created nonindustrial jobs for women, such as clerking, professional work, domestic service, clerical work.

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[10] According to Anderson and Plambeck, family size was not an important family characteristic in determining participation in the New York counties in which their study was made. See **The Social Participation of Farm Families**, by W. A. Anderson and Hans H. Plambeck, Dept. of Rural Sociology, Mimeo. Bulletin 8, Cornell University Agricultural Experiment Station, Ithaca, New York, March, 1943. Most students of participation have found low participation scores to be correlated with the presence of small children in the family. Ages of children in families of this study were not coded; numbers of persons under 14 years were, however, coded. The average number of persons under 14 years per family was in the Jones County Farm group, .6; Off-farm group, .8; Part-farm group, 1.1; Other group, .6. The average number of persons under 14 years per family in the Lee County Farm group, was .4; Off-farm group, .8; Part-farm group, .9; Other group, .7.

Net income patterns of families in the four source-of-family-income groups in the two counties were similar. Net incomes of families in the Off-farm and Part-farm groups were more than double those of families in the Farm and Other groups. Nor were these differences accounted for by differences in goods furnished by the farm. Residual income (net income minus expenditures for food and housing) of families in the Off-farm and Part-farm groups was likewise about twice as high as that of families in the other two groups.

Families in the Farm, Off-farm and Part-farm groups were classified into two net income classes ($0-$999 and $1000 and over) and their manner of living compared. There were too few families in the Other group to break into income classes.

Families in the $0-$999 income class in all three source-of-family-income groups had patterns of family living not too different. Families with net incomes of $0-$999 in every source-of-income group lived at the minimum. The majority of families in each group incurred net deficits during the year of the study. But the situation was more acute for the Farm group, since about two-thirds of the families in this group had net incomes of $0-$999. The percentages for families in the Off-farm and Part-farm groups with net incomes of $0-$999 were about 20 and 33 respectively.

At the $1000 and over net income level, there were more differences in manner of living of families in the three source-of-family-income groups. Farm families spent less for living than did families in the other two groups. They had poorer housing facilities and equipment. Members less often consulted a dentist than members in the other groups. Families in the Part-farm group had living patterns more like those of the Off-farm group. However, they produced about as much food for home use as families in the Farm group.

Male heads and wives in families of the Part-farm group participated more in community organizations than did male heads and wives in families in the other groups.

Industrialization offers opportunities for members of low-income farm families to shift into more remunerative work. It may not help those who continue to devote their time to farming.

Appendix Tables

Table 4. Percentage distribution of families in each of the four source-of-family-income groups classified by net income, Jones and Lee Counties, Mississippi, 1945.

Net income class and county	Source-of-family-income groups [1]			
	Farm	Off-farm	Part-farm	Other
	Percent	Percent	Percent	Percent
$0-$999				
Jones County	70	16	32	52
Lee County	65	19	30	68
$1000 and over				
Jones County	26	84	68	48
Lee County	32	81	68	29

[1] The sum of the percentages of families with net incomes of $0-$999 and with net incomes of $1000 and over will not always equal 100 percent since there were several families with negative incomes not included in the tabulation above.

Table 5. Percentage distribution of families in each of the four source-of-family-income groups classified by farming and farm-tenure status, Jones and Lee Counties, Mississippi, 1945.

Farming and farm-tenure status and counties	Source-of-family-income groups			
	Farm	Off-farm	Part-farm	Other
	Percent	Percent	Percent	Percent
Farming status				
Not a farm operator				
Jones County	0	42	0	48
Lee County	0	59	0	59
Farm operator				
Jones County	100	58	100	52
Lee County	100	41	100	41
Farm-tenure status [1]				
Owner				
Jones County	69	42	70	38
Lee County	40	28	55	23
Renter				
Jones County	8	13	16	14
Lee County	36	12	19	13
Sharecropper				
Jones County	23	3	14	0
Lee County	24	1	26	5

[1] The sum of the percentage of owners, renters, sharecroppers in each of the four source-of-family-income groups is the same as the percentage of farm operators in each of these groups.

Table 6. Percentage of families in each of the four source-of-family-income groups who owned their homes, Jones and Lee Counties, Mississippi, 1945.

County	Source-of-family-income groups			
	Farm	Off-farm	Part-farm	Other
	Percent	Percent	Percent	Percent
Jones County	70	60	70	57
Lee County	40	55	54	46

Table 7. Average net income of families in each of the four source-of-family-income groups classified by net income, Jones and Lee Counties, Mississippi, 1945.

Net income class and county	Source-of-family-income groups			
	Farm	Off-farm	Part-farm	Other [1]
	Dollars	Dollars	Dollars	Dollars
$0-$999				
Jones County	489	650	569	—
Lee County	527	590	631	—
$1000 and over				
Jones County	2075	2501	2231	—
Lee County	1806	2328	2725	—
All families				
Jones County	843	2198	1702	877
Lee County	922	2000	2035	722

[1] Too few families in net income classes to show separately.

Table 8. Average net income, average expenditures for food and housing and average residual income of families in each of the four source-of-family-income groups, Jones and Lee Counties, Mississippi, 1945.

Net income, expenditures for food and housing, residual income and county	Source-of-family-income groups			
	Farm	Off-farm	Part-farm	Other
	Dollars	Dollars	Dollars	Dollars
Net income				
Jones County	843	2198	1702	877
Lee County	922	2000	2035	722
Expenditures for:				
Food [1]				
Jones County	227	670	482	305
Lee County	226	529	360	248
Housing [2]				
Jones County	16	107	66	63
Lee County	9	127	53	34
Residual income				
Jones County	600	1421	1154	509
Lee County	687	1344	1622	440

[1] Excludes share to boarders and farm help.

[2] Family dwelling, vacation dwelling and lodging while away from home.

Table 9. Average residual income of families in each of three source-of-family-income groups classified by net income, Jones and Lee Counties, Mississippi, 1945.

Net income class and county	Source-of-family-income groups		
	Farm	Off-farm	Part-farm [1]
	Dollars	Dollars	Dollars
$0-$999			
Jones County	282	178	203
Lee County	321	281	399
$1000 and over			
Jones County	1717	1664	1597
Lee County	1501	1599	2238

[1] The high average of the $1000 and over Lee County group can be accounted for by large incomes of several families.

Table 10. Average expenditures for family living other than for food and housing of families with net incomes of $0-$999 in each of three source-of-family-income groups, Jones and Lee Counties, Mississippi, 1945.

Kind of expenditures and county	Source-of-family-income groups		
	Farm	Off-farm	Part-farm
	Dollars	Dollars	Dollars
Household operation [1]			
Jones County	82	56	71
Lee County	70	73	81
Furniture and equipment			
Jones County	15	47	32
Lee County	33	31	28
Transportation			
Jones County	4	15	11
Lee County	5	22	7
Auto [2]			
Jones County	21	39	61
Lee County	25	31	18
Personal care			
Jones County	14	24	25
Lee County	15	17	22
Clothing			
Jones County	104	110	156
Lee County	115	123	168
Health			
Jones County	121	78	54
Lee County	44	29	55
Reading			
Jones County	8	3	3
Lee County	3	5	2
Tobacco			
Jones County	15	19	17
Lee County	19	18	17
Recreation			
Jones County	4	7	13
Lee County	11	8	14
Education			
Jones County	1	2	6
Lee County	3	5	7
Miscellaneous [3]			
Jones County	8	8	10
Lee County	13	18	15
All expenditures [4]			
Jones County	397	408	459
Lee County	356	380	434

[1] Fuel, utilities and other household operating expenses.

[2] Only the family's share of the automobile expenses.

[3] Includes burial and health and accident insurance, funeral expenses, legal and other fees, bank service charges and interest on money borrowed for family use.

[4] Other than food and housing.

Table 11. Average expenditures for family living other than for food and housing of families with net incomes of $1000 and over in each of three source-of-family-income groups, Jones and Lee Counties, Mississippi, 1945.

Kind of expenditures and county	Source-of-family-income groups		
	Farm	Off-farm	Part-farm
	Dollars	Dollars	Dollars
Household operation [1]			
Jones County	157	153	131
Lee County	116	155	169
Furniture and equipment			
Jones County	30	96	74
Lee County	72	112	91
Transportation			
Jones County	21	37	30
Lee County	10	43	38
Auto [2]			
Jones County	22	187	139
Lee County	44	139	116
Personal care			
Jones County	35	52	56
Lee County	30	53	44
Clothing			
Jones County	237	260	344
Lee County	267	332	364
Health			
Jones County	140	104	89
Lee County	42	80	63
Reading			
Jones County	9	12	6
Lee County	6	12	11
Tobacco			
Jones County	20	51	42
Lee County	26	42	32
Recreation			
Jones County	16	39	25
Lee County	26	38	30
Education			
Jones County	25	12	11
Lee County	9	16	13
Miscellaneous [3]			
Jones County	10	18	13
Lee County	17	23	13
All expenditures [4]			
Jones County	722	1021	960
Lee County	665	1045	984

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[1] Fuel, utilities and other household operating expenses.

[2] Only the family's share of the automobile expenses.

[3] Includes burial and health and accident insurance, funeral expenses, legal and other fees, bank service charges and interest on money borrowed for family use.

[4] Other than food and housing.

Table 12. Percentage of families in each of three source-of-family-income groups making payments involving specified types of increases in net worth[1] classified by net income, Jones and Lee Counties, Mississippi, 1945.

Net income classes, specified types of increase in net worth and county	Source-of-family-income groups		
	Farm	Off-farm	Part-farm
	Percent	Percent	Percent
$0-$999			
Home improvement			
Jones County	1	12	18
Lee County	2	3	0
Payment life insurance premiums			
Jones County	6	5	14
Lee County	10	18	12
Payment farm mortgage indebtedness			
Jones County	5	0	11
Lee County	4	0	5
$1000 and over			
Home improvement			
Jones County	0	23	16
Lee County	3	13	10
Payment life insurance premiums			
Jones County	4	43	26
Lee County	23	54	33
Payment farm mortgage indebtedness			
Jones County	16	0	11
Lee County	8	2	6

[1] Two percent of the families with net incomes $1000 and over in the Off-farm group of Jones County and three percent of Lee County made payments on non-farm mortgage indebtedness.

Table 13. Average money expenditures for food[1] of families in each of the four source-of-family-income groups classified by net income, Jones and Lee Counties, Mississippi, 1945.

Net income class and county	Source-of-family-income groups			
	Farm	Off-farm	Part-farm	Other[2]
	Dollars	Dollars	Dollars	Dollars
$0-$999				
Jones County	203	422	340	—
Lee County	200	253	222	—
$1000 and over				
Jones County	300	719	547	—
Lee County	291	584	421	—
All families				
Jones County	227	670	482	305
Lee County	226	529	360	248

[1] Excluding share to boarders and farm help.

[2] Too few families in net income classes to show separately.

Table 14. Average number of members[1] in families in each of the four source-of-family income groups classified by net income, Jones and Lee Counties, Mississippi, 1945.

Net income class and county	Source-of-family-income groups			
	Farm	Off-farm	Part-farm	Other[2]
	Dollars	Dollars	Dollars	Dollars
$0-$999				
Jones County	3.55	2.95	5.16	—
Lee County	3.39	2.76	4.29	—
$1000 and over				
Jones County	4.23	3.92	5.14	—
Lee County	4.47	3.58	4.73	—
All families				
Jones County	3.72	3.77	5.15	2.35
Lee County	3.73	3.42	4.56	2.46

[1] In year-equivalent persons.

[2] Too few families in net income classes to show separately.

Table 15. Average money value of home-produced food[1] of families in each of the four source-of-family-income groups classified by net income, Jones and Lee Counties, Mississippi, 1945.

Net income class and county	Source-of-family-income groups			
	Farm	Off-farm	Part-farm	Other[2]
	Dollars	Dollars	Dollars	Dollars
$0-$999				
Jones County	339	184	330	—
Lee County	313	110	277	—
$1000 and over				
Jones County	457	171	454	—
Lee County	395	141	365	—
All families				
Jones County	362	173	414	93
Lee County	335	137	342	107

[1] Includes share to boarders and farm help.

[2] Too few families in net income classes to show separately.

Table 16. Average money value of specified types of home-produced food[1] of families in each of three source-of-family-income groups classified by net income, Jones and Lee Counties, Mississippi, 1945.

Net income classes, specified types of home-produced food and county	Source-of-family-income groups		
	Farm	Off-farm	Part-farm
	Dollars	Dollars	Dollars
$0-$999			
Milk			
Jones County	99	49	85
Lee County	66	18	60
Meat, game, and fish			
Jones County	43	28	29
Lee County	86	16	72
Poultry and eggs			
Jones County	51	41	58
Lee County	59	37	47
Potatoes			
Jones County	36	10	40
Lee County	25	6	19
Vegetables, fruits and nuts			
Jones County	88	50	93
Lee County	66	32	66
Cereals and syrup			
Jones County	22	6	25
Lee County	11	1	13
$1000 and over			
Milk			
Jones County	105	55	120
Lee County	83	41	83
Meat, game, and fish			
Jones County	64	20	61
Lee County	107	26	104
Poultry and eggs			
Jones County	80	38	74
Lee County	85	42	66
Potatoes			
Jones County	44	11	43
Lee County	29	6	27
Vegetables, fruits and nuts			
Jones County	145	43	123
Lee County	83	25	77
Cereals and syrup			
Jones County	19	4	36
Lee County	8	1	8

[1] Includes share to boarders and farm help.

Table 17. Average amount of specified home-produced foods[1] used per person per family in each of three source-of-family-income groups classified by net income, Jones and Lee Counties, Mississippi, 1945.

Net income classes, specified home-produced foods and county	Source-of-family-income groups		
	Farm	Off-farm	Part-farm
$0-$999			
Pork, lbs.			
Jones County	69	52	28
Lee County	146	34	95
Chicken, lbs.			
Jones County	11	18	11
Lee County	19	15	12
Eggs, doz.			
Jones County	24	21	20
Lee County	29	22	19
Sweet Potatoes, lbs.			
Jones County	177	54	144
Lee County	112	24	59
Tomatoes, lbs.			
Jones County	59	31	41
Lee County	62	35	43
Milk, qts.			
Jones County	386	232	228
Lee County	269	91	194
Cabbage, lbs.			
Jones County	17	12	14
Lee County	19	22	18
$1000 and over			
Pork, lbs.			
Jones County	83	24	61
Lee County	137	42	122
Chicken, lbs.			
Jones County	27	9	16
Lee County	21	13	18
Eggs, doz.			
Jones County	27	18	25
Lee County	32	20	21
Sweet Potatoes, lbs.			
Jones County	163	40	145
Lee County	105	14	81
Tomatoes, lbs.			
Jones County	64	23	49
Lee County	65	29	52
Milk, qts.			
Jones County	343	196	323
Lee County	257	160	243
Cabbage, lbs.			
Jones County	29	13	14
Lee County	22	10	19

[1] Includes share to boarders and farm help.

Table 18. Percentage of families in each of the four source-of-family-income groups who were white families, classified by net income, Jones and Lee Counties, Mississippi, 1945.

Net income class and county	Source-of-family-income groups			
	Farm	Off-farm	Part-farm	Other[1]
	Percent	Percent	Percent	Percent
$0-$999				
Jones County	77	78	59	—
Lee County	66	74	49	—
$1000 and over				
Jones County	100	93	96	—
Lee County	82	97	88	—
All families				
Jones County	82	91	84	90
Lee County	72	92	77	83

[1] Too few families in net income classes to show separately.

Table 19. Percentage of families with net incomes of $0-$999 in each of the three source-of-family-income groups classified by farming and farm-tenure status, Jones and Lee Counties, Mississippi, 1945.

Farming and farm-tenure status and county	Source-of-family-income groups		
	Farm	Off-farm	Part-farm
	Percent	Percent	Percent
Farming status			
Not a farm operator			
Jones County	0	33	0
Lee County	0	52	0
Farm operator			
Jones County	100	67	100
Lee County	100	48	100
Farm-tenure status[1]			
Owner			
Jones County	64	37	57
Lee County	33	24	25
Renter			
Jones County	9	20	13
Lee County	37	21	16
Sharecropper			
Jones County	27	10	30
Lee County	30	3	59

[1] The sum of the percentage of owners, renters, sharecroppers in each of the four source-of-family-income groups is the same as the percentage of farm operators in each of these groups.

Table 20. Percentage of families with net incomes of $1000 and over in each of the three source-of-family-income groups classified by farming and farm-tenure status, Jones and Lee Counties, Mississippi, 1945.

Farming and farm-tenure status and county	Source-of-family-income groups		
	Farm	Off-farm	Part-farm
	Percent	Percent	Percent
Farming status			
Not a farm operator			
Jones County	0	44	0
Lee County	0	61	0
Farm operator			
Jones County	100	56	100
Lee County	100	39	100
Farm-tenure status[1]			
Owner			
Jones County	82	43	77
Lee County	53	30	67
Renter			
Jones County	7	12	17
Lee County	33	9	21
Sharecropper			
Jones County	11	1	6
Lee County	14	0	12

[1] See footnote, Table 19.

Table 21. Percentage of families in each of three source-of-family-income groups having specified water and plumbing facilities classified by net income, Jones and Lee Counties, Mississippi, 1945.

Net income classes, specified water and plumbing facilities and county	Source-of-family-income groups		
	Farm	Off-farm	Part-farm
	Percent	Percent	Percent
$0-$999			
Running water			
Jones County	14	14	18
Lee County	7	23	28
Kitchen sink			
Jones County	24	16	15
Lee County	11	15	24
Tub or shower			
Jones County	14	7	7
Lee County	3	15	5
Flush toilet			
Jones County	9	4	4
Lee County	3	15	5
$1000 and over			
Running water			
Jones County	20	55	46
Lee County	29	61	32
Kitchen sink			
Jones County	20	64	55
Lee County	35	55	36
Tub or shower			
Jones County	4	39	24
Lee County	20	39	25
Flush toilet			
Jones County	4	32	12
Lee County	17	42	20

Table 22. Percentage of families in each of the three source-of-family-income groups having specified household equipment classified by net income, Jones and Lee Counties, Mississippi, 1945.

Net income classes, specified household equipment and county	Source-of-family-income groups		
	Farm	Off-farm	Part-farm
	Percent	Percent	Percent
$0-$999			
Self-heating iron			
Jones County	44	38	29
Lee County	29	47	50
Pressure cooker			
Jones County	23	18	32
Lee County	18	3	10
Sewing machine			
Jones County	77	67	61
Lee County	53	56	50
Radio in usable condition			
Jones County	53	51	68
Lee County	52	68	62
Mechanical refrigerator			
Jones County	20	9	11
Lee County	11	18	28
Power washing machine			
Jones County	0	7	1
Lee County	4	15	5
$1000 and over			
Self-heating iron			
Jones County	36	76	85
Lee County	61	81	61
Pressure cooker			
Jones County	68	24	37
Lee County	27	15	31
Sewing machine			
Jones County	100	71	89
Lee County	82	70	77
Radio in usable condition			
Jones County	84	84	81
Lee County	75	90	79
Mechanical refrigerator			
Jones County	4	42	34
Lee County	29	60	48
Power washing machine			
Jones County	0	9	10
Lee County	17	20	13

Table 23. Percentage of family heads in families in each of the four source-of-family-income groups who were under 45 years of age, Jones and Lee Counties, Mississippi, 1945.

County	Source-of-family-income groups			
	Farm	Off-farm	Part-farm	Other
	Percent	Percent	Percent	Percent
Jones County	29	65	44	44
Lee County	45	59	49	49

Table 24. Average number of wool suits, overcoats, and leather or wool jackets owned by male heads in families in each of the four source-of-family-income groups classified by net income, Jones and Lee Counties, Mississippi, 1945.

Net income classes, specified garments and county	Source-of-family-income groups			
	Farm	Off-farm	Part-farm	Other[1]
	Number	Number	Number	Number
$0-$999				
Wool suits				
Jones County	.85	1.08	.91	—
Lee County	1.09	1.00	1.20	—
Overcoats				
Jones County	.51	.28	.61	—
Lee County	.42	.46	.50	—
Leather or wool jackets				
Jones County	.73	.59	.67	—
Lee County	.76	.54	.96	—
$1000 and over				
Wool suits				
Jones County	1.11	1.37	1.21	—
Lee County	.96	1.72	1.48	—
Overcoats				
Jones County	.44	.50	.49	—
Lee County	.57	.63	.46	—
Leather or wool jackets				
Jones County	1.00	1.09	1.01	—
Lee County	1.06	.97	1.01	—
All families				
Wool suits				
Jones County	.98	1.34	1.11	1.03
Lee County	1.06	1.59	1.41	.94
Overcoats				
Jones County	.48	.48	.53	.40
Lee County	.45	.60	.48	.63
Leather or wool jackets				
Jones County	.84	1.02	.90	.91
Lee County	.82	.89	1.01	.88

[1] Too few families in net income classes to show separately.

Table 25. Average number of winter coats, spring coats and felt hats owned by wives[1] in families in each of the four source-of-family-income groups classified by net income, Jones and Lee Counties, Mississippi, 1945.

Net income classes, specified garments and county	Source-of-family-income groups			
	Farm	Off-farm	Part-farm	Other [2]
	Number	Number	Number	Number
$0-$999				
Winter coats				
Jones County	1.10	1.05	1.03	—
Lee County	1.25	.92	1.62	—
Spring coats				
Jones County	.26	.24	.48	—
Lee County	.22	.32	.31	—
Felt hats				
Jones County	.52	.50	.72	—
Lee County	.82	.72	1.08	—
$1000 and over				
Winter coats				
Jones County	1.17	1.19	1.12	—
Lee County	1.41	1.39	1.22	—
Spring coats				
Jones County	.20	.53	.28	—
Lee County	.39	.55	.44	—
Felt hats				
Jones County	.63	.81	.69	—
Lee County	.70	1.05	.85	—
All families				
Winter coats				
Jones County	1.15	1.18	1.09	1.08
Lee County	1.32	1.32	1.40	1.03
Spring coats				
Jones County	.28	.50	.35	.37
Lee County	.26	.52	.40	.44
Felt hats				
Jones County	.65	.77	.71	.66
Lee County	.80	1.00	1.00	.84

[1] A few female heads are included with wives.

[2] Too few families in net income classes to show separately.

Table 26. Percentage of male heads and wives[1] in families with $0-$999 net income in each of the three source-of-family-income groups who attended meetings and made trips during April and May, 1946, Jones and Lee Counties, Mississippi.

Member, meetings and trips attended and made and county	Source-of-family-income groups		
	Farm	Off-farm	Part-farm
	Percent	Percent	Percent
By male heads			
Church			
Jones County	64	67	87
Lee County	64	61	78
Farm			
Jones County	5	0	4
Lee County	1	0	11
Business[2]			
Jones County	0	1	4
Lee County	1	0	2
School			
Jones County	15	24	38
Lee County	12	11	28
Social and civic			
Jones County	0	1	8
Lee County	0	0	2
Trips to towns of 50,000 or more population			
Jones County	10	8	9
Lee County	0	0	15
By wives			
Church			
Jones County	66	67	87
Lee County	65	64	83
Farm			
Jones County	0	0	12
Lee County	4	0	4
Business			
Jones County	0	3	0
Lee County	1	0	0
School			
Jones County	10	10	32
Lee County	13	8	29
Social and civic			
Jones County	0	3	8
Lee County	0	0	2
Trips to towns of 50,000 or more population			
Jones County	16	6	5
Lee County	0	0	4

[1] A few female heads are included with the wives.

[2] Chamber of Commerce meetings, labor union meetings, business and professional club meetings, teachers' meetings, etc.

Table 27. Percentage of male heads and wives[1] in families with $1000 and over net income in each of the three source-of-family-income groups who attended meetings and made trips during April and May, 1946, Jones and Lee Counties, Mississippi.

Member, meetings and trips attended and made and county	Source-of-family-income groups		
	Farm	Off-farm	Part-farm
	Percent	Percent	Percent
By male heads			
Church			
Jones County	73	53	81
Lee County	61	62	78
Farm			
Jones County	9	4	9
Lee County	4	1	6
Business[2]			
Jones County	0	10	5
Lee County	2	8	0
School			
Jones County	36	27	40
Lee County	11	22	22
Social and civic			
Jones County	0	2	0
Lee County	0	7	2
Trips to towns of 50,000 or more population			
Jones County	0	12	10
Lee County	2	13	6
By wives			
Church			
Jones County	74	65	85
Lee County	70	74	70
Farm			
Jones County	17	11	15
Lee County	7	4	9
Business			
Jones County	11	1	2
Lee County	0	0	0
School			
Jones County	35	38	40
Lee County	17	25	21
Social and civic			
Jones County	0	6	3
Lee County	0	9	3
Trips to towns of 50,000 or more population			
Jones County	0	15	9
Lee County	4	8	7

[1] A few female heads are included with the wives.

[2] Chamber of Commerce meetings, labor union meetings, business and professional club meetings, teacher's meetings, etc.

Table 28. Percentage of male heads and of wives[1] in families in each of the four source-of-family-income groups who had completed nine or more grades in school, Jones and Lee Counties, Mississippi, 1945.

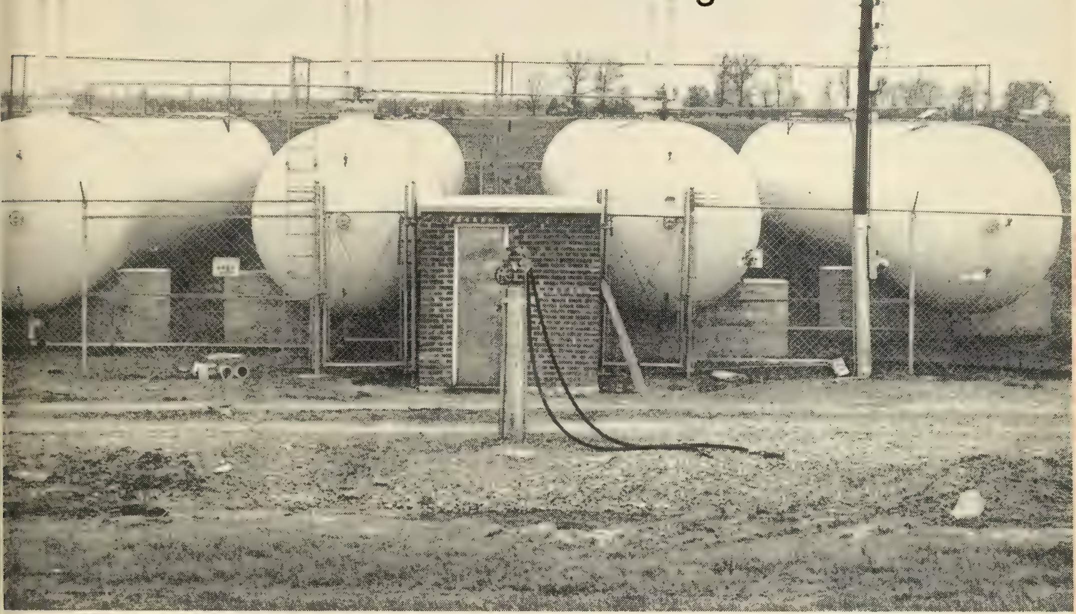
Member and county	Source-of-family-income groups			
	Farm	Off-farm	Part-farm	Other
	Percent	Percent	Percent	Percent
Male heads				
Jones County	27	47	37	25
Lee County	20	53	39	17
Wives				
Jones County	31	56	46	38
Lee County	27	55	43	41

[1] A few female heads are included with wives.

BULLETIN 482 APRIL 1951

Anhydrous Ammonia

As A Source Of Nitrogen



MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
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Anhydrous Ammonia as a Source of Nitrogen

By W. B. ANDREWS, J. A. NEELY, and F. E. EDWARDS[1]

Prior to 1850 nitrogen was obtained from animal manures, green manure crops, and legumes grown in rotation. During the last one hundred years nitrogenous fertilizers have come into general use for crop production. In some sections nitrogenous fertilizers supply most of the nitrogen applied to crops; in others, organic materials are still the primary source of nitrogen.

The population of the United States increased about nineteen million from 1940 to 1950 and the indications are that it will continue to increase. The increasing population, combined with the prospective continued decrease in the relative number of farm workers, will increase the intensiveness of farming and, no doubt, the total amount of nitrogen, as well as other fertilizers, used.

The primary sources of nitrogen used directly by farmers are nitrate of soda, ammonium nitrate, or a mixture of ammonium nitrate and limestone. Ammonium nitrate, urea, and sulphate of ammonia are used in mixed fertilizers.

About one hundred years ago attempts were made to use a solution of ammonia and water (aqua ammonia) as a source of nitrogen in Europe. Since this practice did not develop, it is reasonable to assume that the equipment for handling and applying aqua ammonia was not suitable at that time.

In 1930, J. O. Smith, who was a member of the staff of the Mississippi Delta Branch Experiment Station at Stoneville, applied anhydrous ammonia in the field. He mounted a small anhydrous ammonia cylinder on a mule-drawn plow in such a manner that the ammonia was released in the soil.

The Shell Development Company started using anhydrous ammonia in irrigation water in California in the early thirties. The company recognized the possibility of applying it directly to the soil in the late thirties and patented (Patent No. 2,285,932, June 9, 1942) its use for this purpose; however, so far as the authors know, no one is paying a license fee.

In 1943, the Mississippi Agricultural Experiment Station started work on the application of aqua ammonia to field crops. In 1944, work, in cooperation with the Tennessee Valley Authority, was started on the use of anhydrous ammonia for crop production. After data had been obtained on the value of anhydrous ammonia for crop production and equipment had been developed for its application, the information was released to farmers the first of March, 1947. The anhydrous ammonia used by Mississippi farmers has been as follows:

1947 (Spring)	2,253 tons
1947-1948	12,873 tons
1948-1949	27,433 tons
1949-1950	29,862 tons.

Anhydrous ammonia used in the 1949-1950 fertilizer year was sufficient to fertilize one million acres at 49 pounds of nitrogen per acre. In addition, 1,094 tons of aqua ammonia was used.

After the use of anhydrous ammonia was started by Mississippi farmers, its use moved quickly into other states. By early 1951 there were bulk stations in Alabama, Arizona, Arkansas, Colorado, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Mississippi, Missouri, Nebraska, New Mexico, North Carolina, Ohio, Oklahoma, Oregon, South Carolina, Tennessee, Texas, Washington, and Cuba. In these states the ammonia is handled according to methods worked out by the Mississippi Experiment Station and there were indications that other states would also use anhydrous ammonia in the near future.

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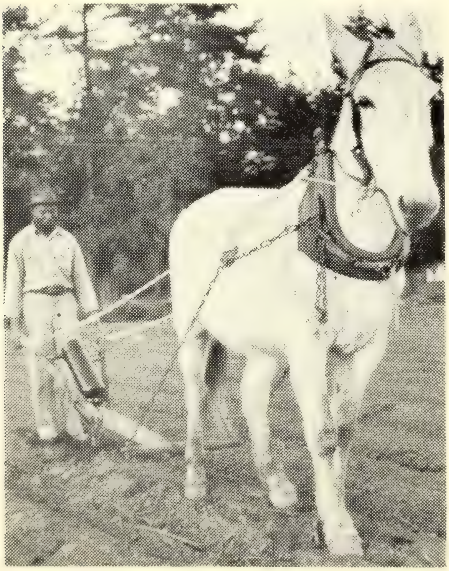
Nitrate of soda from Chile, ammonia from coking coal, and ammonia made in synthetic nitrogen plants supply most of the nitrogen used in this country. Ammonia derived from coal is usually converted into sulphate of ammonia. That produced synthetically is used largely for making ammonium nitrate and urea, in solutions of ammonia and ammonium nitrate and urea in mixed fertilizers, for direct application, and in making a small amount of other sources of nitrogen. Since anhydrous ammonia is used to make other sources of nitrogen, it is apparent that its direct use would be economical.



This photo shows how anhydrous ammonia was first used at the Mississippi Delta Branch Experiment Station in 1930.

The rapid expansion of the use of anhydrous ammonia was due in a large measure to its low cost. The 1950 retail price of anhydrous ammonia was usually $110 to $150 per ton, with $130 being a common price in established territories. With a price of $130 per ton of anhydrous ammonia, one pound of nitrogen costs 8 cents as compared to 12 cents in ammonium nitrate at $79.20 per ton, and a considerably higher cost in other sources of nitrogen.

In practice anhydrous ammonia is applied to row crops with considerably less labor and often more rapidly than solid sources of nitrogen.

Properties of Anhydrous Ammonia

Anhydrous ammonia contains 82 percent nitrogen. It weighs 5 pounds and contains 4.1 pounds of nitrogen per gallon at 80 degrees F. At lower temperatures it weighs slightly more and at higher temperatures slightly less. Anhydrous ammonia is a gas at atmospheric pressure and normal temperatures. At –28 degress F. and lower and at atmospheric pressure it is a liquid. Anhydrous ammonia has a gauge pressure of 75 pounds per square inch at a temperature of 50 degrees F., and 197 pounds at 100 degrees.

Anhydrous ammonia is handled as a liquid under pressure. It is stored in tanks which have a working pressure of 250 pounds per square inch, except where they are underground or refrigerated. The information now available suggests that the atmospheric temperature may not get high enough for 30,000-gallon tanks to pop-off provided the pop valve begins to operate at about 240 pounds of pressure per square inch.

Mississippi "House Bill No. 91, Regular Legislative Session Laws of 1948," authorizes the Motor Vehicle Comptroller (Jackson, Mississippi) to establish and enforce reasonable rules and regulations for the purpose of carrying out the provisions of the "Liquefied Compressed Gas Equipment Inspection Act."

"These rules and regulations shall be complied with by all persons, firms, or corporations engaged in the use, installation, manufacture, or sale of equipment and containers in the utilization, transportation and storage of anhydrous ammonia, when used as a source of nitrogen in the State of Mississippi." All fittings are made of steel and, in the case of hose, materials which are not attacked by ammonia.

Anhydrous ammonia is not considered an explosive; however, when air contains 16 to 25 percent anhydrous ammonia it may be ignited by a spark, causing an explosion. Openings in tanks which contain a mixture of air and ammonia should not be welded, because of explosion hazards. Anhydrous ammonia is much lighter than air and rises quickly except where brought down by wind. In agricultural use, it is handled outside of buildings making unlikely the combination of circumstances required for an explosion.

In low concentrations ammonia is very irritating to the nose, eyes, mouth, throat and lungs. It will blister the skin. Water should always be available for washing off any ammonia which comes in contact with the body.

Anhydrous ammonia should contain over 99 percent ammonia. Insofar as the authors know inspectors have not found ammonia which had been diluted. A general idea of the purity may be obtained by collecting a quart jar full of ammonia and permitting it to evaporate. It is desirable to cover the jar with a top, which has several holes in it, to prevent a little water in the air from accumulating in the jar. Evaporation can be speeded up by setting the jar of ammonia in a shallow pan of water. When the ammonia stops boiling, water containing 25 to 30 percent ammonia should be present only in the depressions in the bottom of the jar. If any significant amount of water is present, dilution is indicated and the inspector may be contacted.

Properties of Aqua Ammonia

Anhydrous ammonia may be diluted with water to make a solution containing 25 to 30 percent ammonia at ordinary temperatures; however, high pressure tanks are required and considerable heat is given off in the process. Even though it is possible to dilute anhydrous ammonia on the farm or at the local bulk station, special equipment is required, except where dilution is made over a period of a day or two and time is allowed for it to cool to atmospheric temperature. Cooling and dilution may be speeded up by running water over the dilution tank and by the use of special equipment.

Aqua ammonia containing 30 percent ammonia exerts no pressure below 70 degrees F., and 10 pounds per square inch at 110 degrees F. A 30 percent ammonia solution contains 24.6 percent nitrogen. One gallon weighs 7.4 pounds and contains 1.85 pounds of nitrogen.

Choice Between Anhydrous and Aqua Ammonia

When applied to the soil, anhydrous and aqua ammonia behave alike. Either form must be covered at the time of application. Since the products formed in the soil are identical, when they are properly applied there is no difference in the response of crops to them.

Anhydrous ammonia tanks are less than one-half as large as aqua ammonia tanks for a given amount of nitrogen, but are much heavier. With the same total load, at least two trips are required for aqua ammonia to move the same number of pounds of nitrogen as would be moved in one trip with anhydrous ammonia. For this reason anhydrous ammonia is less expensive to transport and apply.

Where anhydrous ammonia is exposed to the air it boils vigorously. The serious loss of ammonia is clearly evident, and the operator tries to prevent it. Where aqua ammonia is exposed to the air it does not boil; however, it does lose ammonia rapidly. Since the loss of ammonia from aqua ammonia is not easily estimated, farmers sometimes transport it in open tanks and apply it on the surface of the land to be covered later, both of which result in large losses of ammonia.

On the basis of the authors' experience, a good job of handling and applying anhydrous ammonia is done, but aqua ammonia is often handled and applied inefficiently. Even though aqua ammonia can be handled and applied efficiently, it appears doubtful that it will be so used by the average farmer.

Acidity of Sources of Nitrogen

Most of the sources of nitrogen used in mixed fertilizers and as materials are acid forming, which means that they leach lime out of the soil; however, a few sources increase the lime content of the soil. In mixed fertilizers, the acidity of the nitrogen sources is often neutralized with dolomitic lime. The amount of 90 percent lime gained or lost from the soil by the use of different sources of nitrogen is shown in Table 1.

Anhydrous ammonia, ammonium nitrate, and uramon have a slightly acid effect on the soil. In order to maintain the lime content of the soil where these sources of nitrogen are used it is necessary to apply some lime to the soil periodically. The cost of the lime needed is relatively low. Lime may be used at 10-year intervals to maintain the lime content of the soil where these sources of nitrogen are used. Sulphate of ammonia is about three times as acid forming as anhydrous ammonia, ammonium nitrate and uramon. Nitrate of soda and cyanamid increase the lime content of the soil slightly; however, the increase is not sufficient to markedly increase the lime.

One should become lime conscious and take care of the lime needs of the soil where acid-forming sources of nitrogen are used; however, there is no need to be alarmed about the immediate effect of anhydrous ammonia and ammonium nitrate on the acidity of the soil.

Factors Affecting Crop Response To Ammonia

When anhydrous ammonia is applied to the soil it goes into solution in the soil water (aqua ammonia is in solution), and moves only until it comes in contact with enough clay and organic matter to hold it, after which it does not move. In tests, nitrogen applied at rates of 100 pounds per acre as anhydrous ammonia has come in contact with a cross section of about 16 square inches in a sandy loam soil when the applicators were spaced 42 inches apart. The area covered is larger in more sandy soils and smaller in soils containing more clay. In order for plants to use ammonia they must grow roots to where it is applied.

Since plants must grow roots to where ammonia is applied, it is necessary that it be applied relatively close to small slow-growing plants, like cotton, in order for them to get it while they are young. Anhydrous ammonia applied half way be-

Table 1. The effect of sources of nitrogen on the lime content of the soil.

Source of nitrogen	Pounds of 90 percent lime gained or lost	
	1 lb. of nitrogen	320 lbs. of nitrogen
Anhydrous ammonia	2.0 lost	640 lost
Ammonium nitrate	2.0 lost	640 lost
Cyanamid	3.17 gain	1014 gain
Nitrate of soda	2.0 gain	640 gain
Sulphate of ammonia	6.0 lost	1920 lost
Uramon	2.0 lost	640 lost

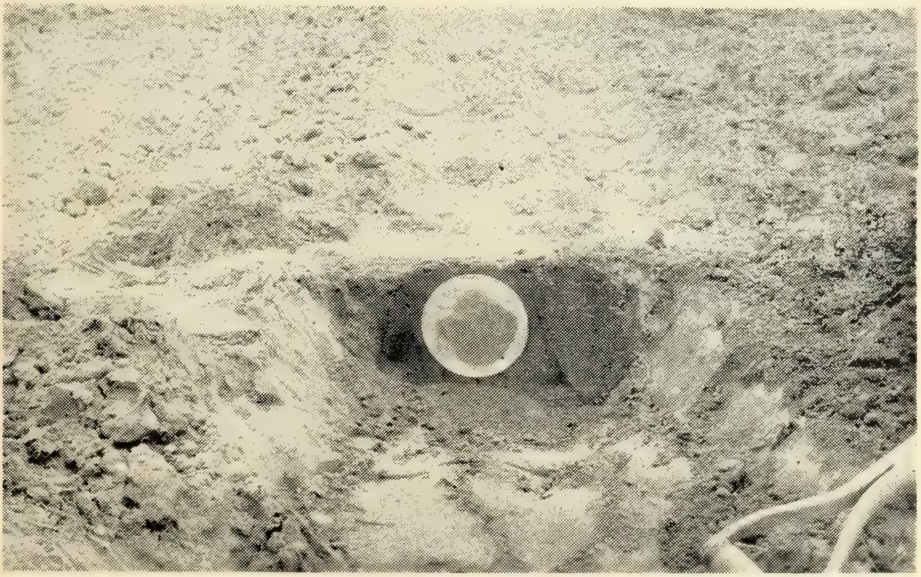
tween the rows of cotton would have about the same effect as a very late side dressing. Under boll weevil conditions, the necessity for rapid development of the young cotton plant requires applying the nitrogen relatively close to the plant. This would not necessarily hold true where soils are naturally very high in nitrogen. Crops like corn which grow rapidly and send their roots out quickly are able to utilize ammonia applied in the middles at the time of sidedressing; however, with small corn some time is required for the roots to reach it.

When ammonia is applied to the soil it readily goes on the clay and organic matter. When applied well below the surface of soils containing free lime it is also held by the soil. The authors have applied 200 pounds of nitrogen per acre as anhydrous ammonia with one applicator in rows 40 inches apart at a depth of 5 to 6 inches without any noticeable loss of ammonia. On extremely sandy soils it should be applied deeper or more than one applicator per 40-inch row should be used where a very high rate of application is made.

Ammonia is a gas at ordinary temperatures and atmospheric pressure. In order that it not be lost, it is necessary that either anhydrous or aqua ammonia be applied 4 or more inches deep and covered simultaneously. If exposed to the air ammonia from both anhydrous and aqua ammonia is lost.

Ammonia may be applied in surface irrigation water as used for rice; however, the soil where the water first comes into the field absorbs more ammonia than that farther away. The different rates of nitrogen obtained in this manner may result in uneven maturity and ripening, which in turn may cause harvesting problems. Ammonia cannot be applied in sprinkling systems without very large losses.

Ammonia which is on clay and organic matter in the soil does not leach out. It is held in the soil even though excessive



When released in the soil anhydrous ammonia does not move far. Filter paper containing a dye was used in this test to show that 100 pounds of nitrogen per acre in 42-inch rows covered about 16 square inches in a sandy loam soil.

rains come. Leaching of nitrogen applied as ammonia does not take place until after it is converted into nitrate nitrogen; only nitrate nitrogen leaches.

During warm weather most ammonia is changed into nitrate nitrogens in about 6 weeks in soils which have a good supply of lime, and which are well drained. The rate of conversion of ammonia into nitrates is slow during cold weather, in excessively wet soils, and in soils which are low in lime.

Data presented below show that in soils with a good supply of lime, anhydrous ammonia applied to oats from October to December was largely lost before spring; where the soils were low in lime the ammonia was retained by the soil through the winter and was present for use in the spring. These differences are attributed to differences in the rate of nitrification.

Young cotton and corn plants grow off more rapidly when ammonia is the source of nitrogen as compared to nitrate nitrogen. Since young corn grows off much more rapidly than young cotton, the advantage of ammonium nitrogen is much more noticeable with corn than with cotton. Young oats, and probably other young small grains, apparently use ammonium and nitrate nitrogen equally well; however, fall-planted oats apparently make little use of ammonia in the spring and it must be converted into nitrates before it is utilized efficiently. Most plants in an advanced stage of growth show better response to nitrates than to ammonia; however, in our experiments corn has utilized ammonia as well as nitrates, even though they were applied late in the season.

For side dressing, ammonium nitrate has been superior to anhydrous ammonia for cotton where both were applied four to six inches deep.

Where the ammonium form of nitrogen is to be used to give young plants a quick start, it is necessary that it be applied immediately before planting or while the plants are very small. If ammonia is applied to fertile soils several weeks in advance of planting it is converted into the nitrate form before the young plants use it.

When crops are exposed to the fumes of ammonia the leaves are killed; however, the buds are usually not killed and growth is resumed. Very young cotton plants may be completely killed by ammonia fumes. In side dressing, it is therefore, doubly important that either anhydrous or aqua ammonia be applied properly, for in addition to injuring the plants, noticeable ammonia fumes mean also that nitrogen is being lost.

Anhydrous ammonia and other fertilizers kill cotton and other seedlings when placed too close to the seed.

Ammonia kills seed when it is placed in contact with or just below them. It is important that ammonia be placed so that it will be at least 3 inches below or to the side of the seed. If there is any doubt about whether or not seed may come in contact with ammonia if put in the center of the bed, the ammonia should be put in the side of the bed. In order to avoid possible injury to the seed and young plants, it is recommended that the ammonia be applied about 4 inches to the side of where the seed are to be placed and 4 to 6 inches below the seed level.

When no odor can be detected at the point where the ammonia was applied, the soil may be plowed up without loss of nitrogen. In most cases, the odor of ammonia disappears within 24 hours after application.

Ammonia and Fuels Form Poison

Experiments at State College show that when a mixture of anhydrous ammonia and butane or propane is burned, hydrocyanic acid, which is very poisonous, is formed. Propane or butane, which is to be used for household purposes, should not be put into tanks which have been previously used for anhydrous ammonia unless the ammonia is completely removed.

Ammonia may be completely removed from tanks by first draining the liquid ammonia and then blowing the fumes out or filling the tanks with water, which will absorb the ammonia, and draining. No odor of ammonia should remain in tanks which are to receive household butane or propane.

Marvin Gieger, Chemist.

Response of Crops to Anhydrous Ammonia

Anhydrous ammonia has been compared to ammonium nitrate in numerous tests, and in a few cases other sources of nitrogen have been included. Time, depth and rate of application have been variables. Usually, there were six replications of the treatments in each corn and cotton test, except those reported from Stoneville where there were four. In tests other than corn and cotton there were four replications. In most tests the treatments were randomized or were in randomized blocks. A blanket application of superphosphate and potash in amounts considered adequate was made on all tests conducted outside of the Delta.

Both anhydrous ammonia and ammonium nitrate are slightly acid forming, sulphate of ammonia is strongly acid forming, and nitrate of soda and cyanamid increase the lime in the soil slightly. However, the tests have been conducted for too short a period for the effect of the sources of nitrogen to exert a noticeable effect on the lime content of the soils.

Even though young plants grow off more rapidly where the source of nitrogen is ammonia than where it is nitrate, there is probably no difference in yield due to the form of nitrogen utilized by the plant. Where differences in yield were obtained from the use of anhydrous ammonia in comparison with other sources of nitrogen, the difference is probably due to differences in the amount of nitrogen which was actually used by the plant.

Since all of the nitrogen in anhydrous ammonia is in the ammonium form, and that in ammonium nitrate is half nitrate and half ammonium nitrogen, less leaching of nitrogen from anhydrous ammonia would be anticipated before the ammonia is converted into nitrate. The nitrogen in nitrate of soda is in the nitrate form which is subject to leaching; however, on some soils the sodium in nitrate of soda increases the yield of cotton, sugar beets, and some other crops. The nitrogen in uramon and cyanamid has to be changed to the ammonium form before plants can use it.

Cotton

Anhydrous ammonia was first compared to ammonium nitrate in side dressing tests conducted in 1944. The fertilizers were applied in June; the weather was

Table 2. The response of cotton to side dressing with anhydrous ammonia and ammonium nitrate on a dry year.

Location	Source of nitrogen	
	Anhydrous ammonia 5 inches deep	Ammonium nitrate surface
	Increase in yield, pounds seed cotton per acre	
Eupora	193	175
Marks	242 (305)[1]	92 (180)[1]
Shuqualak	258	104
Heathman	98	48
Stoneville	305	159
Stoneville	105	125
Yazoo City	207	225
Valley Hill	263	215

[1] The first figures are for the first picking. The second picking was lost. The figures in parenthesis are based upon the first picking and boll counts.

Table 3. The response of cotton to anhydrous ammonia and ammonium nitrate at several locations in 1945, 1946 and 1947.

Location	Source of nitrogen, pounds per acre, depth of application, and time of application								
	Ammonium nitrate 32 lbs. N 4" deep preplant	Anhydrous ammonia 32 lbs. N 4" deep preplant	Anhydrous ammonia 32 lbs. N 6" deep preplant	Anhydrous ammonia 32 lbs. N 4" deep side dress	Ammonium nitrate 4" deep 32 lbs. N side dress	Ammonium nitrate 32 lbs. N surface side dress	Check no nitrogen	Anhydrous ammonia 64 lbs. N 4" deep preplant	Anhydrous ammonia 64 lbs. N 6" deep preplant
	Yield in pounds seed cotton per acre								
Greenwood[1]	1310	1175	1432	1338	1433	1410	1013	1240	1303
Lambert	2160	2130	2443	2375	2370	2297	2013	2660	2607
Columbus	953	1150	1072	1100	1177	1143	703	1343	1180
Holly Springs	1907	1942	1923	1860	1875	2002	1433	2237	2240
Tomnolen	1485	1710	1720	1350	1470	1510	1130	1440	1380
Columbus	1263	1352	1507	1458	1302	1423	1120	1320	1453
Indianola	1593	1723	1707	1563	1503	1583	1523	1633	1663
Indianola	1785	1710	1690	1630	1725	1720	1205	1945	1860
Holly Springs	1270	1274	1412	1308	1264	1258	756	1362	1520
Lambert	2127	2353	2183	2190	2177	2073	1983	2313	2290
Starkville	1473	1568	1487	1487	1565	1472	1148	1455	1373
Tomnolen	1215	1265	1408	1228	1353	1188	755	1310	1323
Aberdeen	430	453	527	407	417	503	217	563	643
Clarksdale	2750	2888	2944	2514	2824	2620	2402	3024	3094
Roundaway	1426	1396	1572	1542	1264	1274	1216	1462	1538
Lambert	1130	1094	1102	1124	1068	1090	998	1144	1100
Morgan City	1352	1404	1478	1402	1460	1356	1100	1672	1718
Holly Springs	1023	1122	1080	947	1014	1048	863	1048	1076
Columbus	890	1080	1036	1082	1048	996	682	1052	944
Average 18 tests	1457	1534	1572	1476	1493	1475	1180	1610	1611
Average increase	277	354	392	296	313	295	-------	430	431

[1] Omitted from average due to loss of ammonia in application at the 4-inch depth of application.

dry at the time of application and continued dry in most places where the tests were conducted. The ammonium nitrate was applied on the surface of the soil. The anhydrous ammonia was applied about 5 inches deep. The rate of nitrogen was 32 pounds per acre.

Anhydrous ammonia was much superior to ammonium nitrate in most of the tests (Table 2), which is attributed to the anhydrous ammonia being placed in the root zone where it was available to the plants even though little rainfall followed application. The ammonium nitrate was placed on the surface where much of it remained because there was insufficient rain to completely carry it into the root zone.

The differences in the efficiency of anhydrous ammonia and ammonium nitrate in these tests were due to positional availability. In order to seal anhydrous ammonia it is necessary to apply it 4 or more inches deep, while ammonium nitrate may be, and is commonly, applied on the surface of the soil in side dressing. These data emphasize, primarly, the desirability of applying solid sources of nitrogen in the root zone when dry weather is likely to follow, rather than a difference in the potential efficiency of these sources of nitrogen when used as a side dressing.

Anhydrous ammonia and ammonium nitrate were compared in 18 tests during 1945-1947 and 12 tests in 1948-1950. Time, rate, and depth of application of nitrogen were variables in the tests, as shown in Tables 3 and 4. Boll weevils limited yields markedly in some tests. The individual tests may be studied; however, there are no differences which can be accounted for on the basis of soil differences.

Where anhydrous ammonia and ammonium nitrate were applied at the rate of 32 pounds of nitrogen per acre before planting, the following increases in yield were obtained:

Source of nitrogen 32 lbs. per acre	Depth of application inches	Increase in yield per acre pounds seed cotton		
		1945-47	1948-50	Average
Ammonium nitrate	4	277	329*	298
Anhydrous ammonia	4	354	324*	342
Anhydrous ammonia	6	392	------	------
Number of tests		18	12	30

*Applied five inches deep.

Anhydrous ammonia increased the yield 342 pounds of seed cotton per acre as compared to 298 pounds for ammonium nitrate at the 4- and 5-inch depth of application. The superiority of the anhydrous ammonia of 44 pounds of seed cotton is attributed to less leaching of nitrogen during the first 8 weeks after application because all of its nitrogen was in the ammonium form which is not subject to leaching, while only half of that in ammonium nitrate is in the non-leaching ammonium form. After 8 weeks all of the nitrogen from both sources should be in the nitrate form on most soils, after which there would be no difference in the leaching.

At the 64-pound rate of application anhydrous ammonia and ammonium nitrate produced the same yields in 18 experiments in 1945-47; in the 12 1948-50 experiments anhydrous ammonia produced 71 pounds more seed cotton than ammonium nitrate at this rate of application.

Broadcast application of ammonium nitrate before planting was almost as efficient as drill application.

The 6-inch depth of application of anhydrous ammonia produced an average

Table 4. The response of cotton to anhydrous ammonia and ammonium nitrate at several locations in 1948, 1949, and 1950. Source of nitrogen, pounds of actual nitrogen per acre, depth of application in inches, and time of application.

Location of test***	Ammonium nitrate, 64 lbs. 5" preplant	Anhydrous ammonia, 64 lbs. 5" preplant	Anhydrous ammonia, 32 lbs. 5" preplant	Ammonium nitrate, 32 lbs. 5" preplant	Ammonium nitrate, 32 lbs., B'd c't. preplant	Ammonium nitrate, 32 lbs. surface, early side-dress	Ammonium nitrate, 32 lbs., 5" early side-dress	Anhydrous ammonia, 32 lbs., 5" early side-dress	Ammonium nitrate, 32 lbs. surface, late side-dress	Ammonium nitrate, 32 lbs., 5" late side-dress	Anhydrous ammonia, 32 lbs. 5" late side-dress	Check no nitrogen
(1948)					Yield in pounds of seed cotton per acre.							
Holly Springs	1582	1667	1348	1400	1332	1308	1365	1447	1468	1603	1247	1007
Newton	1437	1380	1319	1303	1301	1275	1237	1101	1288	1328	1323	926
Clarksdale	2442	2648	2390	2490	2277	2052	2340	2047	2250	2505	2233	1807
Roundaway	2366	2636	2038	2138	2350	1996	2312	1978	2434	2346	2188	1888
(1949)												
Parchman	1980	2094	1968	1798	1838	1921	1978	1888	1625	1878	1880	1591
Brooksville	1328	1292	1068	1128	1096	996	1180	1044	1020	1032	880	816
Newton	422	391	321	303	262	282	299	315	235	260	255	120
Holly Springs**	1121	1163	987	936	985	830	920	930	No Late side-dressing applied			585
(1950)												
Parchman	700	718	654	650	656	617	656	636	580	584	606	452
Morgan City	1510	1618	1496	1518	1436	1514	1486	1464	1286	1450	1344	1352
Brooksville	1132	1084	844	936	980	860	1016	920	980	964	952	756
Holly Springs	785	1058	972	928	840	950	925	830	840	955	930	695
Newton	1782	1734	1442	1329	1368	1320	1294	1433	1298	1289	1446	562
Average	1456	1527	1322	1327	1311	1258	1341	1259	1275	1350	1274	998
Average increase	458	529	324	329	313	260	343	261	277	352	276	

**Omitted from average.

***Tests at Holly Springs, Brooksville and Newton, were on the same site each year.

of 38 pounds of seed cotton per acre more than the 4-inch depth. The superiority of the 6-inch depth of application is attributed to this depth being slightly more favorable for cotton, or possibly to a slower rate of nitrification which would result in less leaching of nitrogen.

Results reported in Table 3 show that the 6-inch depth of application of anhydrous ammonia was considerably superior to the 4-inch depth in a few tests, was inferior in a very few tests, and there was little difference in many tests. In one two-year test at Stoneville a 6-inch depth of application of both anhydrous ammonia and ammonium nitrate made about 100 pounds more seed cotton than the 4-inch depth and the 8-inch depth made about 100 pounds more than the 6-inch depth. The advantage for deeper application of anhydrous ammonia is usually greater when extremely dry weather follows.

From a practical standpoint anhydrous ammonia is more easily sealed in the soil when applied 6 inches deep than when applied 4 inches deep. Deeper applications are more expensive. Taking everything into consideration, it appears that the most reasonable depth of application is 6 inches.

In side dressing young cotton, the distance away from the young plants is important on poor soils. Young cotton grows off slowly and extends its roots out slowly. If the ammonia is applied 5 to 6 inches from small cotton the roots begin to take it up in a short time. If it is applied farther away it has the effect of a delayed side dressing which is undesirable with cotton. Where soils have sufficient nitrogen for cotton to grow off rapidly the distance of side dressing from the plant is less important.

When anhydrous ammonia and ammonium nitrate were used as an early side dressing for cotton the following results were obtained.

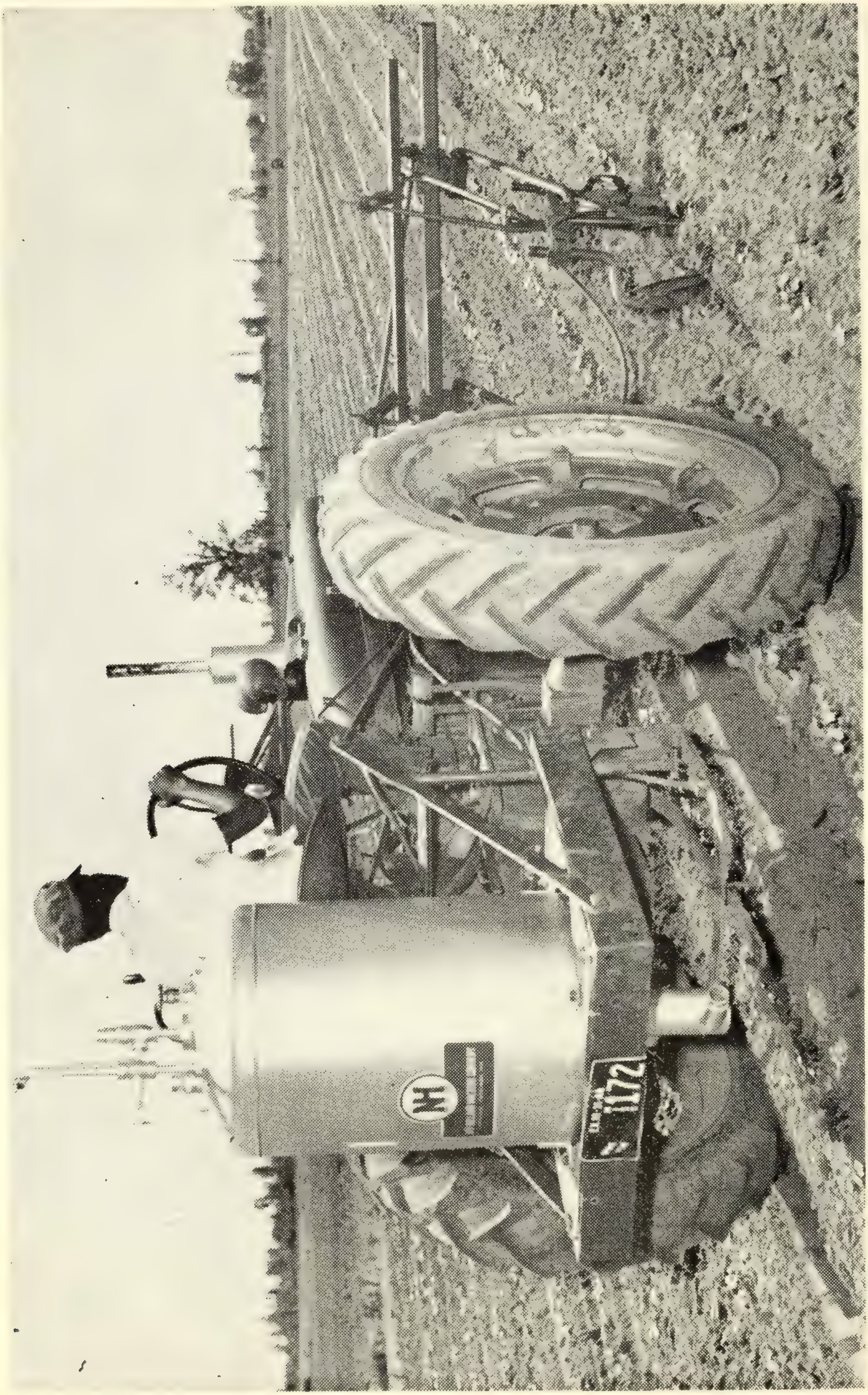
Source of nitrogen 32 lbs. per acre	Depth of application inches	Increase in yield per acre, pounds seed cotton		
		1945-47	1948-50	Average
Anhydrous ammonia	4	296	261*	282
Ammonium nitrate	4	313	343*	325
Ammonium nitrate	Surface	295	260	281
Number of experiments	----	18	12	30

*Applied 5 inches deep.

Anhydrous ammonia applied 4 or 5 inches deep and ammonium nitrate applied on the surface made the same increase in yield of cotton. Ammonium nitrate applied at the same depth as anhydrous ammonia made 43 pounds more seed cotton than anhydrous ammonia in an average of 30 tests, which suggests that ammonium nitrate is slightly superior to anhydrous ammonia for side dressing provided both are placed 4 or 5 inches deep.

The late side dressings were applied in June in the 12 tests (Table 4), and in these tests, in which 32 pounds of nitrogen was applied, the June side dressings produced almost exactly the same increase in yield as the May side dressings. In one test at Stoneville side dressing and preplanting application of 30 pounds of nitrogen per acre produced the same increase in yield; however, where 45, 60 and 75 pounds of nitrogen was applied per acre side dressing was considerably inferior to preplanting or split application.

It should also be pointed out that ammonium nitrate at 32 pounds of nitrogen per acre, 4 and 5 inches deep, produced an average of 27 pounds more seed cot-



Anhydrous ammonia is applied before planting cotton or as a side dressing.

ton when applied as an early side dressing than when applied just before planting. However, anhydrous ammonia applied just before planting produced 60 pounds more seed cotton than when used as a side dressing.

In using anhydrous ammonia the normal anticipated needs of cotton for nitrogen should be applied just before planting, and side dressing with additional nitrogen should be applied in June where cotton appears to need more nitrogen.

As has been pointed out, the 64-pound rate of nitrogen was only slightly superior to the 32-pound rate, on the average which no doubt is associated with the severity of boll weevil damage. However, there were some good increases due to the higher rate of nitrogen. Some of the larger increases for the higher rate of nitrogen were obtained where 1900 to 2400 pounds of seed cotton was obtained with the lower rate. It appears that the yield per acre on low-producing soils which are capable of high yields might be increased to a very high level by the use of high amounts of nitrogen and other fertilizers. Where soils are well drained and no serious disease exists it appears that yields equal to the highest reported are possible where sufficient fertilizer is used and insects are controlled.

Large amounts of nitrogen increase stalk growth and reduce yields where insects are not controlled. However, early fruiting, which is obtained with early insect control, tends to prevent excessive stalk growth.

The response of cotton to five sources of nitrogen in the Mississippi Delta is shown in Table 5. The data are 6-year averages for 30, 45 and 60 pounds of nitrogen per acre at four locations. There was little difference between the yields produced with anhydrous ammonia and ammonium nitrate; however, these two sources of nitrogen produced some higher yields than nitrate of soda, sulphate of ammonia and cyanamid.

The effects of time of application of anhydrous ammonia and ammonium nitrate are variable. Results reported below show that anhydrous ammonia applied to oats produced excellent increases in yield when applied in October or December to soils of pH 5.0 or lower, and poor results when applied to soils of pH 5.45 or higher. The poor results for fall application on the latter soils were, no doubt, due to the conversion of the ammonia to nitrate nitrogen and subsequent leaching out before spring. On soils of pH 5.0 or lower the change of ammonia into nitrate nitrogen was much slower, as shown by laboratory tests.

December application of ammonium nitrate was considerably inferior to May preplanting application on both the sandy and the heavy soil (Table 6). December application of anhydrous ammonia was as good as May application in two sandy land tests. On the heavy soil both the December and the May applications of anhydrous ammonia were less than half as efficient as ammonium nitrate applied in May. The poor results from anhydrous ammonia applied in December on the heavy soil are attributed to the growth of weeds which consumed a large part of

Table 5. The response of cotton to sources of nitrogen, 1945-50.

Source of nitrogen[1]	Stoneville	Yazoo City	Money	Onward	Average	Increase
		Yield in pounds seed cotton per acre				
Anhydrous ammonia	2247	1997	1783	1872	1975	542
Ammonium nitrate	2286	1953	1828	1786	1963	530
Cyanamid	2212	1902	1796	1779	1922	489
Sulphate of ammonia	2254	1930	1787	1760	1933	500
Nitrate of soda	2190	2021	1811	1780	1951	518
No nitrogen	1807	1496	1440	990	1433	------

[1] Average of 30, 45 and 60 pounds of nitrogen per acre for each location.

the anhydrous ammonia. The poor results from the May application of anhydrous ammonia are attributed to the loss of ammonia in application because of the poor physical condition of the soil.

It appears that application of anhydrous ammonia earlier than December results in more leaching and a greater growth of weeds, which further reduces the efficiency of fall-applied ammonia.

The uncertainties in the efficiency of anhydrous ammonia applied in the fall and early winter apparently justify a general conclusion that it is uneconomical to apply anhydrous ammonia to row crops before early spring.

Corn

In 1944 seven side-dressing tests and one preplanting test were conducted with corn. In 1945, 1946, and 1947 five tests were conducted in which both preplanting and side-dressing applications were made, and in thirteen tests side dressing applications only were made. The stands of corn were usually considered adequate; however, the stands were not adjusted to the rate of nitrogen. In tests conducted since 1947 arbitrary stands were used for the different nitrogen levels.

The first use of anhydrous ammonia on corn was in 1944 when seven side-dressings tests were put out in June, and very dry weather followed (Table 7). The rate of application was 32 pounds of nitrogen per acre. Anhydrous ammonia was applied 5 inches deep and the ammonium nitrate was applied on the surface. Response to anhydrous ammonia was almost normal in three of the tests, low in two, and very low in three tests. Response to ammonium nitrate was about normal in one test, and very low in seven tests. Anhydrous ammonia was superior to ammonium nitrate in all but one of these tests and much superior in most of them. The inferiority of the ammonium nitrate is attributed to the lack of sufficient rain to carry it into the root zone. The results emphasize the desirability of applying solid sources of nitrogen in the root zone when rain may be insufficient to carry the nitrogen into the root zone.

Preplanting and side dressing applications at 32 pounds of nitrogen per acre were about equally effective for producing corn (Table 8). The average data for the side dressing treatments for the 18 tests (Table 9) are as follows:

Source of nitrogen, 32 lbs per acre	Depth of application inches	Increase in yield per acre corn, bushels
Anhydrous ammonia	4	16.2
Ammonium nitrate	4	14.3
Ammonium nitrate	surface	13.1

Anhydrous ammonia produced 1.9 bushels more corn on the average than ammonium nitrate. Ammonium nitrate applied 4 inches deep produced only 1.2 bushels more than when applied on the surface, which contrasts sharply with the data above where the differences were much greater. In the latter tests the side-dressing applications were usually made during May and there was more time for the rain to carry the nitrogen into the soil; while in the former experiments the

Table 6. The influence of time of application of anhydrous ammonia and ammonium nitrate, applied at the rate of 60 pounds of nitrogen per acre, on the yield of cotton.

Time of application	Sandy loam soil, 1949-1950			Clay (buckshot) soil, 1950	
	Test 1	Test 2		Test 3	
	Anhydrous ammonia	Anhydrous ammonia	Ammonium nitrate	Anhydrous ammonia	Ammonium nitrate
	Increase in yield, pounds seed cotton per acre				
December (preplant)	752	568	462	315	372
May (preplant)	716	585	624	319	727
June (side dress)	626	------	------	------	------
July (side dress)	485	------	------	------	------

Table 7. The response of corn to side dressing with anhydrous ammonia and ammonium nitrate on a dry year.

Location	Anhydrous ammonia 5 inches deep	Ammonium nitrate surface
	Increase in yield, bushels corn per acre	
Eupora	10.8	8.2
Marks	5.6	2.2
State College	12.5	8.6
State College	13.8	4.5
Tomnolen	13.4	13.0
Shuqualak	6.2	3.4
Valley Hill	10.0	7.2

Table 8.The response of corn to anhydrous ammonia and ammonium nitrate, 1945 and 1946.

Location	Source of nitrogen, rate per acre, and depth of application								
	Ammonium nitrate 32 lbs. N 4" deep preplant	Anhydrous ammonia 32 lbs. N 4" deep preplant	Anhydrous ammonia 32 lbs. N. 6" deep preplant	Anhydrous ammonia 32 lbs. N 4" deep side dress	Ammonium nitrate 32 lbs. N 4" deep side dress	Ammonium nitrate 32 lbs. N surface side dress	Check no nitrogen	Anhydrous ammonia 64 lbs. N 4" deep preplant	Anhydrous ammonia 64 lbs. N 6" deep preplant
	Yield in bushels per acre								
Columbus	24.2	28.3	27.8	27.4	27.8	28.5	12.1	38.9	37.7
Starkville	21.8	26.0	29.1	34.6	28.7	26.2	12.4	38.4	40.2
Tomnolen	55.3	56.1	55.9	57.8	55.3	54.6	42.8	60.6	61.8
Holly Springs	82.8	84.6	82.5	79.1	79.5	80.6	69.9	84.8	77.8
Holly Springs	66.3	60.5	66.7	69.5	62.3	63.7	56.0	72.8	69.8
Average	50.1	51.1	52.4	53.7	50.7	50.7	38.6	59.1	57.5
Average increase	11.5	12.5	13.8	15.1	12.1	12.1		20.5	18.9

Table 9. The response of corn to anhydrous ammonia and ammonium nitrate applied as a side dressing: 1945, 1946, and 1947.

Location	Source of nitrogen, rate per acre, and depth of application						
	Check no nitrogen	Anhydrous ammmonia 32 lbs. N 6" deep	Anhydrous ammmonia 32 lbs. N 4" deep	Ammonium nitrate 32 lbs. N 4" deep	Ammonium nitrate 32 lbs. N surface	Anhydrous ammmonia 64 lbs. N 4" deep	Anhydrous ammmonia 64 lbs. N 6" deep
	Yield in bushels per acre						
West Point	54.1	59.2	60.3	58.2	59.6	68.3	65.4
State College	61.8	75.9	73.2	73.8	68.6	79.8	84.8
State College	33.8	41.4	37.3	40.8	35.2	43.5	47.2
Starkville	11.7	34.6	33.8	28.1	27.4	39.4	40.1
Columbus	13.6	37.1	36.1	34.2	35.1	46.2	49.9
Aberdeen	19.3	44.1	42.3	40.6	35.2	54.0	51.4
Columbus	5.6	34.3	34.7	33.0	33.9	48.4	47.6
Starkville	40.3	46.2	47.0	48.8	50.9	56.3	57.4
Columbus	22.2	42.9	44.4	46.3	39.3	50.5	53.9
Sessums	37.0	47.7	46.5	40.5	43.1	60.7	58.1
New Hope	31.2	51.6	52.3	50.2	46.9	54.7	59.0
Columbus	18.6	46.7	45.6	43.7	44.1	56.9	57.9
Columbus	11.0	22.7	22.8	17.7	16.6	19.4	19.8
Average increase		17.3	16.6	15.1	13.5	24.5	25.6

Table 10. The response of corn to anhydrous ammonia and ammonium nitrate at several locations in 1948, 1949, and 1950.

	Source of nitrogen, pounds of actual nitrogen per acre, depth of application in inches, time of application and plants per acre.											
Location of test****	Anhydrous ammonia, 100 lbs. pre-plant, 200 lbs. early side-dress 5", 16,000	Anhydrous ammonia, 100 lbs. pre-plant, 100 lbs. early side-dress 5", 12,000	Ammonium nitrate 100 lbs. preplant 100 lbs. early side-dress 5" 12,000	Ammonium nitrate 100 lbs. late side-dress surface, 8,000	Ammonium nitrate 100 lbs. late side-dress 5", 8,000	Anhydrous ammonia 100 lbs. late side-dress 5", 8,000	Ammonium nitrate 100 lbs. early side-dress surface, 8,000	Ammonium nitrate 100 lbs. early side-dress 5", 8,000	Anhydrous ammonia, 100 lbs. early side-dress 5", 8,000	Anhydrous ammonia, 100 lbs. pre-plant 5", 8,000	Ammonium nitrate 100 lbs. pre-plant 5", 8,000	Check no nitrogen
(1948)					Yield in bushels of corn per acre							
Holly Springs	70.5**	95.0	87.0	74.5	76.9	73.9	74.9	76.6	75.4	71.4	69.2	34.3
Newton	21.3**	27.3**	26.7**	34.5	33.9	36.8	30.9	29.8	31.8	26.5	27.4	5.6
(1949)												
Brooksville	80.7	84.7	75.3	72.0	76.3	76.0	72.1	77.3	70.6	65.4	60.6	35.7
Parchman	77.7	79.2	76.2	72.0	76.6	77.5	76.3	71.8	65.2	75.4	69.5	53.7
Newton	85.6	91.0	80.3	69.8	67.6	70.6	64.2	71.9	72.3	63.4	64.4	9.7
Holly Springs	71.6	87.3	84.9	No late side-dress			73.1	70.7	62.2	79.1	72.7	23.6
Oakley	72.9	74.4	76.6	No late side-dress			53.2	48.6	49.3	66.0	55.7	21.8
(1950)												
Newton	63.2**	70.7	67.9	60.1	69.1	65.4	58.0	68.8	69.1	60.5	53.9	4.3
Morgan City	113.3	87.3	95.2	75.2	83.3	86.9	82.4	80.3	87.4	89.1	72.8	37.4
Holly Springs	118.9	118.5	126.8	92.6	91.5	86.6	102.0	98.9	106.1	103.9	94.1	39.2
Brooksville	58.0***	55.3***	58.7***	65.3	65.2	59.1	55.7	52.5	58.6	55.6	56.0	38.6
Average	75.8	79.2	77.8	68.4	71.2	70.3	67.5	67.9	68.0	68.8	63.3	27.6
Average increase	48.2	51.6	50.2	40.8	43.6	42.7	39.9	40.3	40.4	41.2	35.7	——

**The intended stand was not fully obtained.

***Disease damaged the high plant population plots.

****Tests at Holly Springs and Newton were on the same site each year.

applications were made later in the season and very dry weather followed.

Deep applications of nitrogen used as a side dressing becomes increasingly important as summer approaches, when prolonged dry periods are frequent, and as side dressing is delayed until crops are larger. Where crops are planted early and side dressed early, depth of application of solids is probably of little importance. Ammonia must be applied 4 to 6 inches deep in order for it to be covered and retained by the soil.

Where depth of application of nitrogenous fertilizers is a factor in crop production, and with conventional equipment for applying both liquid and solid sources of nitrogen, anhydrous ammonia may be applied at deeper depths more easily than solid sources of nitrogen.

Anhydrous ammonia and ammonium nitrate were compared for corn production in eleven tests with high rates of nitrogen (Table 10). With 100 pounds of nitrogen and 8,000 plants per acre anhydrous ammonia made 5.2 bushels more corn than ammonium nitrate when applied before planting. As an early side dressing there was no difference in the response to anhydrous ammonia and ammonium nitrate at the 5-inch depth of application, and ammonium nitrate applied on the surface. When side dressed late there was little difference between ammonium nitrate on the surface and 5 inches deep, and anhydrous ammonia 5 inches deep. In other experiments ammonium nitrate applied on the surface has given poor results when dry weather followed.

Application of 200 and 300 pounds of nitrogen with 12,000 and 16,000 plants per acre, respectively, produced about 10 bushels more corn on the average than 8,000 plants and 100 pounds of nitrogen.

In many tests the corn with the higher rates of nitrogen was affected more adversely by diseases, and there was much more lodging on these plots.

December application of both anhydrous ammonia and ammonium nitrate at the rate of 120 pounds of nitrogen resulted in a yield of eight bushels of corn less than April application in one test at Stoneville:

Time of application	Source of nitrogen: Anhydrous ammonia	Source of nitrogen: Ammonium nitrate
	Increase, bushels per acre	
December (preplant)	32.4	30.7
April (preplant)	40.3	38.6
June (side dress)	35.1	38.6

December application stimulated growth of weeds and grass which consumed part of the nitrogen. The efficiency of the nitrogen was low in these tests. If a higher efficiency had been obtained from the spring applications, superiority of the spring applications may have been still larger. Earlier application would, no doubt, stimulate the growth of weeds and grass more, and increase the time for leaching.

Side dressing stimulated the growth of grass in the corn, as compared to preplanting applications.

Oats for Grain

Oats for grain are commonly planted in October and early November. They usually make little growth before spring regardless of the fertility of the soil unless the winter is mild ,which means that little of the nitrogen is used in the fall and winter. In order for nitrogen to be available to oats for grain it must be present in the soil in early spring. The length of time nitrogen stays in the soil depends upon its form and upon the rainfall. Ammonia does not leach out of the soil; nitrogen leaches as the nitrate. The rate of change of ammonia to nitrate nitrogen is dependent upon the lime content of the soil, its temperature and the moisture content. In addition, young oats apparently use ammonia and nitrate nitrogen equally well, while fall planted oats apparently prefer nitrate nitrogen in the spring of the year.

During 1945-1946 ten tests were conducted with oats in which ammonium nitrate and anhydrous ammonia were applied in the fall; ammonium nitrate was applied in the spring, and anhydrous ammonia was applied in the winter or spring in three tests (Table 11). When applied in the fall the ammonium nitrate was a poor source of nitrogen in all tests as compared to anhydrous ammonia applied in the fall or to ammonium nitrate applied in the spring.

On four of the more acid soils anhydrous ammonia applied in the fall was superior to spring-applied ammonium nitrate. The soil in test number four had a pH of 4.95 on which aqua ammonia applied in January was as good as ammonium nitrate in March. The soil in test number 5 had a pH of 5.1; on this soil anhydrous ammonia applied in early March was inferior to ammonium nitrate at the same time. The rate of change of ammonia to nitrate nitrogen was slow on these soils, which enabled the fall- and winter-applied ammonia to be retained until spring and prevented the oats in test No. 5 from getting nitrate nitrogen in time for it to be fully effective.

On the soils which were above pH 5.45 anhydrous ammonia applied in the fall was not nearly as effective as ammonium nitrate applied in the spring. In test No. 10 (pH 7.8) anhydrous ammonia and ammonium nitrate applied in March were equally effective. The failure of anhydrous ammonia to go through the winter on these soils and its high efficiency when applied in March on one soil were due to the high rate of change of ammonia into nitrates. Ammonium nitrate applied in October gave poor results in all tests.

The data reported in Table 12 show that October application of anhydrous ammonia to oats was unsatisfactory in the first three tests which were high in lime; on the fourth soil, which was strongly acid, anhydrous ammonia was about equal to ammonium nitrate. Anhydrous ammonia applied the last of November on three soils which were high in lime was considerably inferior to a February application. When applied the last of February, anhydrous ammonia was superior to ammonium nitrate in all tests, and practically as good when applied during the first week in March.

The effect of anhydrous ammonia applicator spacing on the yield of oats for grain is reported in Table 13. The fertilizers were applied about the first of March, a little late for anhydrous ammonia on many soils, and the ammonium nitrate was a little superior to anhydrous ammonia. The data show that anhydrous

Table 11. The response of oats to fall-applied anhydrous ammonia and to fall and spring applied ammonium nitrate—32 pounds of nitrogen per acre.

Test No.	Ammonium nitrate		Anhydrous ammonia	
	Increase in yield—bushels oats per acre			
	Soils below pH 5.1			
	Fall	Spring	Fall	Spring
1	30	—	16	21
2	32	—	15	25
3	30	—	16	25
4	29	30*	20	27
5	19	10**	10	19
	Soils above pH 5.1			
6	25	—	15	30
7	12	—	8	19
8	15	—	8	22
9	14	—	10	24
10	4	25**	5	24

*Applied in January.

**Applied in March.

ammonia may be applied with very satisfactory results with the applicators spaced up to 32 inches apart.

Observations have been made that when the anhydrous ammonia applicators are spaced farther apart than 16 inches many of the oats do not receive any benefit from the nitrogen. The failure of this to be reflected more definitely in the yield is not understood. Where soils are well drained the lateral spread of roots is greater; where they are poorly drained oats may not get nitrogen more than 6 inches from the point of application, which means that the applicators should be placed closer together on poorly drained soils.

In one test where anhydrous ammonia was applied to a sandy soil in October at the rate of 48 pounds of nitrogen per acre the yield of oats was 38, 37, and 33 bushels for 24, 18, and 12 inch spacings of the applicators, respectively.

As has been pointed out anhydrous ammonia moves only until it comes in contact with enough soil to hold it, which is a very short distance. In order for oats to get nitrogen applied as anhydrous ammonia it is necessary for them to grow roots to the point of application of the ammonia.

Oats are sometimes winter killed by being heaved out of the soil by ice because the root system is too small to hold them in the soil. The application of nitrogen to oats in the fall on soils which

Table 12. The response of oats to anhydrous ammonia and ammonium nitrate, 1946-1947.

Nitrogen treatment		Date of	Location and yield in bushels oats per acre							
Source	Lbs. N per acre	application	Lambert	Greenwood	Columbus	Shelby	Clarksdale	Columbus	Columbus	Holly Springs
None	----	......	36.9	50.0	34.9	25.8	23.1	26.3	14.6	5.0
Anhydrous ammonia	32	Oct.	45.1	53.9	39.7	......	......	......	......	16.5
Anhydrous ammonia	64	Oct.	41.9	58.0	50.6	......	......	......	......	24.9
Ammonium nitrate	32	Feb.	58.7	62.2	51.7	30.0	42.5	45.5*	40.4*	18.0
Anhydrous ammonia	32	Feb.	59.1	67.1	58.9	35.2	52.3	41.3*	35.9*	21.8
Anhydrous ammonia	64	Feb.	65.6	74.7	65.2	58.8	70.0	......	......	34.5
Ammonium nitrate	64	Feb.	69.8	62.7	......	43.3	58.2	......	......	30.0
Anhydrous ammonia	32	Nov.	55.2	53.0	50.8	......	......	......	......	......

*Applied the first week in March.

Table 13. The effect of spacing of applicators on the yield of oats for grain.

Nitrogen*		Applicator spacing inches	Yield—bushels per acre					
			Test number					
Source	Lbs. per acre		1	2	3	4	5	6
Check No nitrogen	----	----	38	5	11	11	18	14
Ammonium nitrate	32	Broadcast	58	31	51	----	----	----
Anhydrous ammonia	32	16	59	21	42	37	----	----
Anhydrous ammonia	32	24	59	23	43	37	----	----
Anhydrous ammonia	32	32	57	17	44	35	----	----
Anhydrous ammonia	48	16	----	----	----	----	42	31
Anhydrous ammonia	48	24	----	----	----	----	37	30
Anhydrous ammonia	48	32	----	----	----	----	38	29
Ammonium nitrate	64	Broadcast	71	32	62	----	----	----
Anhydrous ammonia	64	16	62	27	54	39	----	----
Anhydrous ammonia	64	24	66	23	47	39	----	----
Anhydrous ammonia	64	32	54	21	46	39	----	----
Anhydrous ammonia	96	16	----	----	----	----	49	31
Anhydrous ammonia	96	24	----	----	----	----	42	31
Anhydrous ammonia	96	32	----	----	----	----	37	34

*Time of application—first of March.

Table 14. The response of fall-planted oats to anhydrous ammonia and ammonium nitrate as measured by forage and grain yields.

Nitrogen treatment			Yield per acre test number				
	Time and rate		Air-dry forage			Grain	
Source	Fall	Spring	Test 1	Test 2	Test 3[1]	Test 1	Test 2
	Lb. N	Lb. N	Lb.	Lb.	Lb.	Bu.	Bu.
Anhydrous ammonia	32	----	1072	720	883	25	19
Ammonium nitrate	32	----	883	443	822	24	17
Ammonium nitrate	64	----	1892	817	1334	23	21
Anhydrous ammonia	64	----	1840	1251	1351	24	17
Anhydrous ammonia	32	32	1098	703	792	43	40
Ammonium nitrate	32	32	953	355	758	46	44
Ammonium nitrate	----	32	73	15	94	45	41
Anhydrous ammonia	----	32	60	16	-------	39	36
Anhydrous ammonia	----	32	-------	-------	-------	44	36
Ammonium nitrate	----	32	-------	-------	-------	50	41
No nitrogen	----	----	-------	-------	-------	26	15

[1] First week in December clipping only.

were very low in nitrogen prevented the heaving of oats in three of the tests conducted. Young oats are very responsive to phosphorus and lime. It is evident that the application of any element which is deficient in the soil would also prevent heaving of oats and other small grains.

Oats For Forage

The response of oats for forage and grain to sources of nitrogen is shown in Table 14. The three tests were put out the last week in September with the anhydrous ammonia being applied just before planting and the ammonium nitrate two weeks later after the oats were up. Anhydrous ammonia was considerably superior to ammonium nitrate for the production of forage in one test at the 32- and 64-pound rates. There was insufficient rainfall to carry the ammonium nitrate into the root zone soon after it was applied, and the superiority of the anhydrous ammonia was, no doubt, due to positional availability. Since dry weather in the fall is not uncommon the desirability of plowing solid sources of nitrogen into the soil before planting oats is suggested.

Data on the response of oats for forage and grain to anhydrous ammonia and ammonium nitrate are reported in Table 15. The time of application was September and December for forage, and March for grain. There was little difference between the yields where anhydrous ammonia and ammonium nitrate were applied, and 96 pounds of nitrogen in September was as effective as 48 pounds in September and December.

Where the yield of forage without nitrogen was 1,160 pounds per acre or more, 48 pounds of nitrogen per acre was apparently sufficient for most economical forage production; where the yield of forage without nitrogen was about 400 pounds per acre, 96 pounds of nitrogen was more economical except at Brooksville in 1950 where the yields were low because of poor drainage.

During 1948-1949 and 1949-1950, all of the tests produced at least one ton of air-dry forage per acre before March, where sufficient nitrogen had been applied. In some cases only one clipping was made.

It should be pointed out that from one to three clippings were made. Under these conditions oats make more total growth than where they are cut more frequently, and probably much more than

Table 15. The response of oats for forage and grain to anhydrous ammonia and ammonium nitrate—time and rate of application.

Source, rate, time of nitrogen	Brooksville		Holly Springs	Newton		Oakley		Poplar-ville, 1949
	1949	1950		1949	1950	1949	1950	
	(Pounds air-dry forage per acre)							
No nitrogen	1602	265	744	402	385	1270	1362	1160
Anhydrous ammonia 24 lbs. SDM*	2072	744	1686	1440	1668	2083	2001	1653
Anhydrous ammonia 48 lbs. SDM	2537	1135	1788	2036	2685	2066	2290	1915
Ammonium nitrate 48 lbs. SDM	2214	807	2349	2376	2445	2248	2574	1942
Anhydrous ammonia 48 lbs. SD	2651	984	1824	2528	2653	2292	2569	1806
Ammonium nitrate 48 lbs. SD	2291	691	2099	2324	2538	2322	2758	2035
Ammonium nitrate 96 lbs. S	2842	1052	2115	3340	2281	2302	2529	1850
Anhydrous amonia 96 lbs. S	2558	1097	1914	3092	2507	2190	2378	1998
Anhydrous ammonia 96 lbs. S, 48 D	2802	1326	2060	2930	2926	2124	2698	1950
Clipping date	12/9			12/2; 2/26		2/15		12/2; 1/26; 2/11
	Grain yield, bushels per acre where clipped.							
No nitrogen		7	25	2	4	Win-		Kill-
Anhydrous ammonia 24 lbs SDM		34	54	13	24	ter		ed
Anhydrous ammonia 48 lbs. SDM		50	56	16	30	Kill-		by
Ammonium nitrate 48 lbs. SDM		50	53	12	23	ed		rust
Anhydrous ammonia 48 lbs. SD		22	47	8	9			
Ammonium nitrate 48 lbs. SD		25	37	3	4			
Ammonium nitrate 96 lbs. S		11	38	3	4			
Anhydrous ammonia 96 lbs. S		8	46	2	3			
Anhydrous ammonia 96 lbs. S, 48 lbs. D		25	63	9	11			
	Grain yield, bushels per acre—not clipped							
No nitrogen		18	27	6	13			
Anhydrous ammonia 48 lbs. M		43	59	17	33			
Ammonium nitrate 48 lbs. M		45	73	25	38			
Anhydrous ammonia 96 lbs. M		50	74	18	40			
Ammonium nitrate 96 lbs. M		58	81	18	27			

*SDM—September, December or March.

Table 16. The response of oats for forage and grain to anhydrous ammonia and ammonium nitrate, 1949-1950.

Location			Holly Springs				Brooksville			Newton				Oakley		
Nitrogen treatment*			Clipping No. and date				Clipping No. and date			Clipping No. and date				Clipping No. and date		
Source	Lbs. per acre	Date of application**	1 11/8	2 12/23	3 3/7	Total	1 11/7	2 4/9	Total	1 11/2	2 12/24	3 3/3	Total	1 11/7	2 2/16	Total
			Pounds air-dry forage per acre													
No nitrogen	----	....	314	129	301	744	157	108	265	329	22	34	385	1141	221	1362
Anhydrous ammonia	24	SDM	608	401	677	1686	349	395	744	1183	145	361	1689	1443	558	2001
Anhydrous ammonia	48	SDM	431	468	890	1789	578	557	1135	1619	284	783	2686	1443	847	2290
Ammonium nitrate	48	SDM	615	718	1016	2349	355	452	807	1464	347	632	2443	1456	1119	2575
Anhydrous ammonia	48	SD	501	495	828	1824	462	522	984	1648	217	789	2654	1457	1112	2569
Ammonium nitrate	48	SD	558	657	884	2099	361	330	691	1620	302	616	2538	1564	1206	2760
Ammonium nitrate	96	S	626	647	843	2116	618	435	1053	1669	169	444	2282	1401	1128	2529
Anhydrous ammonia	96	S	398	723	793	1914	623	473	1096	1712	347	449	2508	1387	991	2378
(Anhydrous ammonia	96 48	S) M)	516	614	930	2060	665	661	1326	1674	291	962	2927	1504	1194	2698

*All plots received 80 pounds phosphate and 50 pounds potash.

**SDM=September, December and March.

Table 18. The response of cabbage, tomatoes and beans to anhydrous ammonia, ammonium nitrate and nitrate of soda.

Source of nitrogen in 1200 lbs. 6-8-4, and 32 lbs. as side dressing	Depth of application	Cabbage			Tomatoes U.S. No. 1 & 2			Beans
	inches	1948 Lbs.	1949 Lbs.	Av. Lbs.	1948 Lbs.	1949 Lbs.	Av. Lbs.	1948 Bushels
1. Ammonium nitrate	4	18,077	14,946	16,512	8,730	11,276	10,003	184
2. Anhydrous ammonia	4	18,513	13,178*	15,846	8,040	8,501	8,272	180
3. Anhydrous ammonia	6	18,404	12,912*	15,658	9,120	10,831	9,976	171
4. Anhydrous ammonia All before planting	6	18,513	13,089	15,801	7,860	9,593	8,727	176
5. Nitrate of soda	4	18,186	13,973	16,080	9,270	10,256	9,763	152

*Applied about one month later than other sources.

where they are grazed closely. However, clipping more often or grazing should give forage of a higher protein content. The forage harvested usually had a protein content of 18 to 22 percent, which is higher than needed; however, it was as low as 6 percent during the coldest part of the winter. It appears that oat forage could be used more efficiently as only a part of the total feed rather than as the sole source of feed.

When top dressed with nitrogen the first of March, clipping the oats for forage reduced the yield of grain only slightly in two tests, had no effect in one test, increased the yield in one test, and reduced the yield in two tests. Clipping where the top growth is removed is, no doubt, a much more severe treatment than moderate grazing. Close grazing removes the leaf area and prevents large yields from being made. When oats are not grazed too closely, and grazing is stopped before March, and the oats are properly fertilized with nitrogen in February or March, fall and winter grazing do not reduce yield of grain markedly.

The response of oats for forage and grain to anhydrous ammonia and ammonium nitrate for 1949-50 is shown by data reported in Tables 15 and 16. Anhydrous ammonia was as effective as ammonium nitrate for the production of forage. A 96-pound application of nitrogen from ammonium nitrate and anhydrous ammonia was as effective as a 48-pound application in September and December, which means that one application is sufficient for forage production.

The data show that one to one and one-fourth tons of air-dry forage was made in three of the tests and about one-half ton in one test. This suggests that about 48 pounds of nitrogen is sufficient where there is a good supply of nitrogen in the soil, and that up to 96 pounds may be required for the most economical forage yields where soils are low in nitrogen.

Grain yields show that a March application of nitrogen is necessary to produce grain after grazing oats. The reduction in yield for grazing where the oats were re-fertilized with nitrogen in March averaged about 4 bushels, except for one test where the clipped oats were winter killed; however, in the latter case the yield without clipping was low.

Pasture Grasses

Five experiments were conducted in 1950 on pastures. The nitrogen treatments were started in July after the spring clover had disappeared. The weather was very dry at Poplarville where little response to nitrogen was obtained; the rainfall was good at all other locations. There are variations which cannot be accounted for. It will take several years' data to reach a reliable generalization concerning the value of top dressing pastures with nitrogen.

The good treatments (Table 17) produced 1200 to 1600 pounds of air-dry pasture clippings per acre at the four locations which had satisfactory rainfall. One hundred pounds of nitrogen cost about $11 as anhydrous ammonia and about $14 as ammonium nitrate, applied to the land. The value of the grass would be determined by whether or not it furnished normal grazing or prevented a shortage of grass during the summer months. It appears that these increases would be profitable only when they are used in the place of harvested or bought feed, or where they are used to prevent a loss in weight of cattle or a decrease in milk production.

The grasses responded to ammonium nitrate about two weeks earlier than to anhydrous ammonia; however, the reponse was more gradual where anhydrous ammonia was applied.

Even though the moisture was favorable little growth of grasses was made after September 15 with or without nitrogen. This suggests that if grass is to be used for grazing after this date it must be produced earlier.

There was little difference in the production of grass by anhydrous ammonia and ammonium nitrate, and between 16- and 32-inch spacings of the anhydrous ammonia.

Where nitrogen is to be used on summer pastures, observations suggest that it should be applied by the middle of June, rather than in July as was the case with the tests conducted.

Truck Crops

The response of cabbage, beans and tomatoes to anhydrous ammonia, ammonium nitrate and nitrate of soda is shown by the data reported in table 18. For cabbage, anhydrous ammonia was superior to the other two sources of nitrogen in 1948; in 1949 the side dressings of anhydrous ammonia were applied about one month later than the other sources of nitrogen and it was not quite as good as the other sources of nitrogen. Applying all of the nitrogen as anhydrous ammonia before planting cabbage was as effective as split applications of any source.

For tomatoes the 6-inch depth with two applications of anhydrous ammonia was equal to ammonium nitrate and nitrate of soda, and superior to the 4-inch depth of application and one application of anhydrous ammonia. Ammonium nitrate and anhydrous ammonia were superior (significantly) to nitrate of soda for beans. Ammonium nitrate was superior to the anhydrous ammonia treatments; however, the differences were not significant, statistically.

There are too few data to conclude whether or not there is any real difference between ammonium nitrate and anhydrous ammonia for truck crops; however, the data suggests that there is little difference between them for these crops.

Sweetpotatoes

Anhydrous ammonia was compared with nitrate of soda, ammonium sulphate and ammonium nitrate to determine their effects on the yield and quality of Unit I Porto Rico sweetpotatoes at the Coastal Plain Experiment Station at Newton. As may be seen in Table 19, in 1948, anhydrous was second in yield only to nitrate of soda. In 1949, it was second only to ammonium nitrate. In 1950 no response to nitrogen was obtained in the test which suggests that the 1948-1949 average should be given most consideration.

Table 17. Response of pasture grasses after clover to anhydrous ammonia and ammonium nitrate,1950.

Treatment	Lbs. N per A	Date of application	Spacing	Location of tests				
				State College[1]	Verona[2]	Holly Springs[3]	Oakley[3]	Poplarville[3]
				Yield—pounds of air-dry forage per acre				
Check—no nitrogen				3364	2061	2487	1119	902
Ammonium nitrate	33	July,Aug.,Sept.		5015	2815	3181	1827	1317
		July,Sept.	16″	4567	2857	3358	2173	1189
Anhydrous ammonia	45	July,Sept.	32″	4544	2935	3172	1967	1349
Anhydrous ammonia	45	July,Sept.		4815	3189	2936	2013	1502
Ammonium nitrate	45	July		4799	3329	3032	3361	2061
Ammonium nitrate	99	July	16″	4749	3300	3948	2940	1694
Anhydrous ammonia	99	July	32″	4642	3386	4087	2532	1354
Ammonium nitrate	99	Sept.		4162	2514	2255	1056	1187
Anhydrous ammonia	99	Sept.		3794	2123	2481	1121	1061

[1] Total of four clippings.

[2] Total of one clipping. No clipping was made after the September application of nitrogen.

[3] Total of two clippings. No clipping was made after the September application of nitrogen.

When the two- or three-year average yields are compared, the differences in yield between anhydrous ammonia, nitrate of soda and ammonium nitrate are not significant. The yields produced by either of these three nitrogen sources are significantly higher than the yield from sulphate of ammonia.

Sorghum

Anhydrous ammonia was used as a source of nitrogen along with several others for sorghum during the years 1945-1948. Experiments were conducted each year on an Ochlocknee silt loam near Starkville and on a Grenada silt loam near Holly Springs. The differences in yield among the five nitrogen carriers were small, as shown by the yields of sorghum and syrup reported in Table 20.

Sugarcane

The data reported in Table 21 show that, on the average, anhydrous ammonia was equal to or slightly superior to ammonium nitrate for the production of sugarcane. There was no advantage in making two applications of nitrogen instead of one. There was no difference in the quality of the syrup where the two sources of nitrogen were applied.

Table 19. The effect of nitrogen sources on the marketable yield of Unit I Porto Rico sweetpotatoes—Newton.

	Marketable yield in bushels per acre				
Source of nitrogen*	1948	1949	1950	3 year average	1948-49 average
No nitrogen	173	119	131	141	146
Nitrate of soda	203	164	114	160	184
Ammonium sulphate	163	136	114	138	150
Ammonium nitrate	187	186	132	168	186
Anhydrous ammonia	199	167	104	157	183

*Rate of nitrogen 48 lbs. per acre.

Table 20. The response of sorghum to sources of nitrogen.

	Yield	Gallons of syrup	
Source of nitrogen	Tons per acre	per ton	per acre
Sulphate of ammonia	15.45	19.9	310
Nitrate of soda	15.21	20.5	311
Ammonium nitrate	15.59	19.8	308
Anhydrous ammonia	16.31	19.6	318
Sulphate of ammonia neutralized with lime	16.05	20.1	322

Table 21. The response of sugarcane to anhydrous ammonia and ammonium nitrate, 1949-1950.

	Yield—gallons of syrup per acre						
Treatment	Test 1 1949	Test 2 1949	Test 3 1950	Test 4 1950	Test 5 1950	Test 6 1950	Average 6 tests
Anhydrous ammonia[1]	682	852	722	408	625	510	633
Ammonium nitrate[1]	673	773	682	406	630	460	604
Anhydrous ammonia[2]	684	862	711	421	678	449	634
Ammonium nitrate[1]	642	738	749	375	582	475	594
Anhydrous ammonia[3]	711	817	709	360	516	397	585
Ammonium nitrate[3]	681	869	670	352	600	411	597

[1] 60 pounds nitrogen, 80 pounds phosphate, and 40 pounds potash applied in March. .

[2] 30 pounds nitrogen, 80 pounds phosphate, and 40 pounds potash applied in March, and 30 pounds of nitrogen in June.

[3] 60 pounds nitrogen only applied in March.

Equipment for Applying Anhydrous Ammonia

The retail cost of anhydrous ammonia in early 1951 varied from $110 to $150 per ton, the most common price in old territories being about $130 per ton or 8 cents per pound of nitrogen. At the same time the cost of nitrogen in ammonium nitrate was about 12 cents per pound.

Circular 152[2], Mississippi Agricultural Experiment Station, provides an appraisal of the use of 2800 pounds of nitrogen as anhydrous ammonia on 50 acres of farm land. Total cost of machinery and labor for applying anhydrous ammonia was 4.8 cents per pound of nitrogen and that for ammonium nitrate was 1.9 cents per pound. In very large operations these costs were reduced to 1.2 cents for ammonium nitrate and 1.4 cents per pound of nitrogen for anhydrous ammonia. It is evident that the savings in using anhydrous ammonia are much more on the larger operations, which in many cases are increased by maintaining farm storage.

The estimated costs of anhydrous ammonia equipment in Table 22 were taken from Circular 152. The prices are for 1949. Taxes were not included in the estimates. Prices vary considerably from area to area, and as economic conditions change. The estimates are based on purchase price, five percent interest, and a 20-year depreciation period.

The annual storage cost per ton for the bulk station operator is cut in half when the tanks are filled twice during the year. Increasing the number of fillings per year beyond two reduces the cost per ton slightly; however, this reduction is small and might be uneconomical if it influenced the seasonal supply of ammonia markedly.

Where a farmer has a need for about 10 tons of anhydrous ammonia, it appears that a 2,500-gallon storage tank, which could be filled twice or more by the bulk storage operator, would be economical. The cost of this tank should be only a little more than that of a 1,000-gallon trailer tank and trailer. No doubt a reduced price of ammonia for filling farm tanks in off seasons can be obtained and the trailer tank may be eliminated.

Custom Application

With ammonium nitrate costing 12 cents per pound of nitrogen its cost applied to 50 acres of land is about 13.9 cents per pound of nitrogen. With anhydrous ammonia nitrogen costing 8 cents per pound its cost applied to the same area is about 12.8 cents per pound. At

Table 22. Cost of anhydrous ammonia equipment (1949)

Type of ammonia equipment	Capacity tons maximum	Total cost	Annual cost	Storage cost per annual ton of ammonia—No. fillings			
				1	2	3	4
Tractor equipment, depending on number of rows and metering device		$ 300-500					
500-gallon transport tank	1	475	$60.22	....	......	......	......
1,000-gallon transport tank	2	585	67.97	....	......	......	......
Heavy duty trailer	....	290	36.92[1]		....	......	......
6,000-gallon storage tank	12	2.500	283.25	$23.60	$11.80	$7.87	$5.90
18,000-gallon storage tank	36	8.500	739.30	20.54	10.27	6.85	5.13
30,000-gallon storage tank	60	11.500	959.30	15.97	7.99	5.32	4.00

Storage tank costs based on 5 percent interest, 20-year depreciation time and maintenance.

[1] One-half cost to ammonia.

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[2] "An Economic Appraisal of Anhydrous Ammonia as a Nitrogenous Fertilizer," by James P. Gaines and Grady B. Crowe.

this price ratio a farmer who had 50 acres to fertilize could afford to pay about 14 cents per pound of nitrogen for anhydrous ammonia applied to the soil and still do the job as cheaply as with ammonium nitrate.

There are a number of large farmers who prefer to hire a custom applicator to apply anhydrous ammonia even though the cost is more than if they applied it themselves. The difference is that the custom operator adds power and labor to that available on the farm at a time when power and labor are at a premium. There is one disadvantage— the custom applicator may not always be able to put out anhydrous ammonia at the time maximum response would be obtained. This may also be true where a farmer does his own work.

Custom application of solid fertilizers is increasing in many sections of the country. Economies which help to offset the cost of the service are bulk handling, with the elimination of bags and bagging costs, and a reduction in handling where the fertilizer goes directly from the plant to the farm.

Particularly where custom application is practiced, the application of phosphorus or potash, or a mixture of the two at the same time anhydrous ammonia is applied, offers an opportunity for considerable savings in the cost of fertilizers applied to the land. The greatest opportunity for the custom applicator is in areas where a variety of crops are planted, which gives a longer application period.

Where the fertilizer application period is short, it is more difficult to make a profitable business out of custom application.

Rental of Equipment

Since farmers first started using anhydrous ammonia in 1947, the practice is still in its infancy, and the possibilities of its use have not yet been fully realized. As has been pointed out, a farmer fertilizing 50 acres with 2800 pounds of nitrogen could afford to own anhydrous ammonia equipment. However, the field equipment (two-row) would not be used more than three days during the year. In most areas, the fertilizer application period should be 50 or more working days, which means that on a rental basis a farmer with 50 acres or less to fertilize could afford to pay several times the actual cost of the equipment for its use for the limited period. The availability of equipment for rental will, no doubt, increase.

The use of anhydrous ammonia equipment on a rental basis for small acreages on one farm will stimulate the production of equipment which may be changed from one tractor to another quickly. This may be approached from the standpoint of quick-changing tractor-mounted equipment, or trailing equipment may be used. Trailers may carry all of the equipment, or they may carry the tank and metering device with the applicators conventionally mounted on the tractor.

Where large applicator tanks are mounted on trailers to be used in the field they may be used for transporting the ammonia with the elimination of the conventional transport tank where small acreages are involved. A tank carrying 100 gallons of ammonia contains 410 pounds of nitrogen, enough for 10 acres at 41 pounds per acre.

The maximum size trailer tank which a tractor can pull through the field has not yet been established. A factor affecting the size of tank which may be used is whether or not the weight is all carried on the trailer or whether the tractor carries part of the weight. A factor affecting maneuverability is whether the wheels are swiveled or not.

In at least one case the anhydrous ammonia bulk plant operator rents a tractor and all equipment necessary for applying anhydrous ammonia at a very reasonable rate. For the immediate future, this appears to be one of the best means of bringing anhydrous ammonia to the small farms.

Combination of Operations

Anhydrous ammonia is normally applied as a single operation. However, it may be combined with other operations such as cultivating and various breaking operations. Combinations of this type increase the skill needed, but they reduce the total power and labor required.

Anhydrous Ammonia Storage Equipment

Where the use of anhydrous ammonia is established in a state its storage and handling are controlled by regulations. In Mississippi these regulations are enforced by the State Motor Vehicle Comptroller. The requirements outlined below are for conditions as they exist in Mississippi, where the maximum day temperatures rarely exceed 100°F. The specifications would, of course, be different where the maximum temperatures are materially higher or lower than in Mississippi.

Anhydrous ammonia has a gauge pressure of 197 pounds per square inch at 100°F, and 215 pounds at 105°F. The maximum day temperatures never go as high as 105°F., and night temperatures are about 15°F. cooler. In 30,000 gallon tanks the temperature of the ammonia does not go as high as maximum day temperatures nor as low as the minimum night temperatures. It appears that the maximum pressure of anhydrous ammonia in 30,000 gallon tanks should never be as high as 215 pounds per square inch. Small tanks may reach a higher pressure. The recommendations are:

1. 250 pound working pressure A.S. M.E.—A.P.I. code tanks with the pop-off valve set to discharge between 237 and 250 pounds per square inch.

Popping off of anhydrous ammonia tanks is a loss. If popping off of a 30,000-

This tractor is equipped to apply anhydrous ammonia and cultivate at the same time.

gallon tank containing 60 tons of anhydrous ammonia lowers the pressure 10 pounds per square inch, over 300 pounds of ammonia is lost, which is a loss of about $20 each time the valve pops off and lowers the presure 10 pounds. Evidently, provisions must be made to avoid popping off of tanks. It has been reported that some pop-off valves go off at pressures which are much lower than the 237- to 250-pound setting; for this reason the Mississippi regulations require sheds, or provisions for sprinkling.

Bulk storage plant operators should keep a close account of the tanks if the pressure exceeds 200 pounds per square inch to determine whether or not the pop-off valves release at lower pressures than they are set for. If they do so, sheds or sprinkling systems should be provided to prevent the loss of ammonia.

The temperature (and pressure) of small tanks is more quickly changed by changes in the atmospheric temperature than that of larger tanks. They are, therefore, more likley to pop off than larger tanks.

2. Underground tanks for bulk storage of anhydrous ammonia. These tanks are used very little and there are depreciation hazards which are not common to other types of storage.

3. Refrigerated above-ground storage tanks which have a working pressure of less than 250 pounds per square inch. Refrigerated storage tanks are usually limited to Horton spheres which are insulated. However, it is possible that use could be made of some non-insulated lower working pressure tanks for storage of anhydrous ammonia during the winter months, where they are emptied as warmer weather approaches.

For specifications concerning storage tanks and other anhydrous ammonia equipment the reader is referred to:

This tractor is equipped to apply anhydrous ammonia, a mixture of superphosphate and potash, and plant seed in one operation.

1. Rules and Regulations, Liquified Compressed Gas Equipment and Containers, Office of the Motor Vehicle Comptroller, Jackson, Mississippi.
2. The regulations of other states.
3. Standards for the Storage and Handling of Anhydrous Ammonia and Ammonia Solutions, Compressed Gas Association, Inc., 11 West 42nd Street, New York, N. Y.

The size of high pressure anhydrous ammonia storage tanks usually varies from 6,000 to 30,000 gallons. Large tanks are used by dealers and large farmers. Smaller tanks are used by farmers. The Horton spheres usually have a total gallonage of about 210,000 gallons.

Anhydrous ammonia is usually transported in 26-ton tank cars to the local bulk storage plant, where it is transferred into storage. It is usually transported to the farm in 1000-gallon trailer tanks which are taken directly to the field. It is then transferred to tractor tanks holding from 60 to 100 gallons. From these tractor tanks, it is released through a metering device into the soil.

In the manufacture, transportation, and application of anhydrous ammonia to the soil, it is handled by pumps or compressors, or transferred by its own pressure by bleeding vapor from the tank being filled.

Tractor tanks are usually filled from 1000-gallon tanks by bleeding off a small amount of vapor from the tractor tank to lower the pressure. So long as the pressure in the tractor tank is maintained at a pressure no lower than 10 pounds per square inch less that in the 1000-gallon tank, the loss of ammonia is no more than one percent. The loss increases to three percent when the difference in pressure is 40 pounds per square inch. If a tank with a pressure of 232 pounds per square inch were bled to atmospheric pressure the loss would be 36 percent The accumulation of ice or sweating of the tractor tank indicates excessive loss of ammonia in bleeding.

Filling Tanks with Anhydrous Ammonia

Anhydrous ammonia is most frequently transferred to tractor tanks by bleeding gas off the tractor tank; however, pumps and compressors are also used.

Where bleeding is used to fill tractor tanks, after the liquid line has been connected between the tanks, the valves are opened in the following order: (1) Liquid valve on tractor tank (if this valve is not opened automatically), (2) liquid valve in line next to tractor tank (it should be open already), (3) valve on line at storage tank, and (4) vapor escape valve on the tractor tank which should be regulated to maintain 10 pounds less pressure in the tractor tank than in the storage tank. If this pressure is more than 10 pounds lower the loss of ammona is excessive.

When the tank is filled to 90 percent of capacity a white spray starts escaping from the vapor valve. At this time, the valves should be closed in the following order: (1) Valve in line next to storage tank, (2) hose valve next to the tractor tank, (3) vapor escape valve on the tractor tank, and (4) filling valve on the tractor tank. The hose connection is then loosened and the ammonia in the short nipple is drained, after which the connection is completely broken. The filling hose should be drained to prevent bursting, and unintentional release of ammonia on the operator or spectator. If the hose is not to be drained after each filling, it should be equipped with a safety valve; however, it is recommended that it be drained.

Where pumps are used to fill tanks with anhydrous ammonia (1) the vapor line is connected, (2) the vapor valves are opened, (3) the liquid line is connected, after which the order of opening the valves is (4) fill valve on tractor tank, (5) fill valve on hose next to tractor tank, (6) valve on line next to storage tank, and (7) depth fill gauge valve, and then (8) the pump is started.

As soon as the white spray starts to escape from the depth gauge valve the pump should be cut off, and the valves closed in the following order: (1) Valve on line next to storage tank, (2) depth gauge valve on tractor tank, (3) vapor valve on tractor tank, (4) vapor valve on storage tank. Then(5) disconnect vapor line, (6) close liquid valve on hose line next to tractor tank, (8) close fill valve on tractor tank, (9) loosen liquid line connection on tractor tank and let the ammonia in the short nipple drain out. The line is then completely disconnected and drained.

Where compressors are used to fill tanks with anhydrous ammonia, the operation of valves and connections is the same as in filling with the pump except the compressor is connected into the vapor line.

Tractor Equipment

The specifications for tractor tanks and fittings are prescribed in the rules of regulating agencies. There are a large number of manufacturers of anhydrous ammonia tractor equipment. For this reason most of the details of the equipment are omitted from this publication.

Essentially all of the tractor equipment except the devices to regulate the flow of ammonia and the applicators which go into the soil are the same. However, there are many differences in metering devices and applicators. The ammonia comes out of the tractor tank through a metering device, and is divided by means of orifices to the applicators.

Metering Anhydrous Ammonia on Tractor Equipment

The most widely used metering device for anhydrous ammonia is a needle valve and pressure gauge before the orifices. The rate of application of ammonia per acre through this equipment is dependent on:

1. Tank pressure
2. Orifice size
3. Orifice pressure
4. Back pressure in the lines which is determined in part by the line size and the size of the outlet in the applicator
5. Area covered per hour

With variations in orifice size, line size, and size of the outlet in the applicator it is evident that only identical machines would deliver the same quantities of ammonia. For this reason, detailed information on the calibration of one machine is not included in this bulletin. **It is therefore imperative that equipment manufacturers supply calibration data for their machines.**

If the calibration information on a machine in pounds of nitrogen (or ammonia) per hour were available the rate of application of ammonia per acre could be calculated very accurately; however, in actual practice the rate of application per acre is often determined on the basis of experience, rather than by making detailed calculations.

A regulating valve and pressure gauge before the orifices are also widely used for metering anhydrous ammonia. The regulating valve maintains a constant pressure on the orifices; however, since the vaporization of ammonia is related to changes in pressure, the regulating valve does not maintain a constant flow of ammonia. The same factors which affect the rate of flow with a needle valve and pressure gauge also affect the rate of flow through the regulating valve. The manufacturer of equipment using a regulating valve and gauge should supply calibration data with the machine. As is the case with a needle valve and pressure gauge regulator, operators often regulate the flow of ammonia with a regulating valve and gauge on the basis of experience.

A flowrator and cooler are used to regulate the flow of anhydrous ammonia. The flowrator is graduated in pounds of nitrogen per hour, and the rate of flow is indicated by a sight gauge. The error of this instrument has been estimated to be about five percent by the manufacturer. With a known area covered per hour the rate per acre may be calculated quickly. However, farmers may arrive at the rate per acre by experience.

In the cooler the incoming warm ammonia is cooled by the outgoing expanding ammonia. A cooler may be made by putting a coiled 3/4-inch pipe in a three inch pipe about 12 inches long. The expanding ammonia goes out through the coil, while the incoming ammonia comes through the larger pipe. Cooling prevents the ammonia from bubbling in the flowrator and pump. The size of the cooler depends upon the amount of cooling to be done.

The pump and cooler is another means of controlling the rate of application of ammonia to the soil. It is geared to the tractor and should maintain a constant rate of flow, regardless of changes in ammonia pressures.

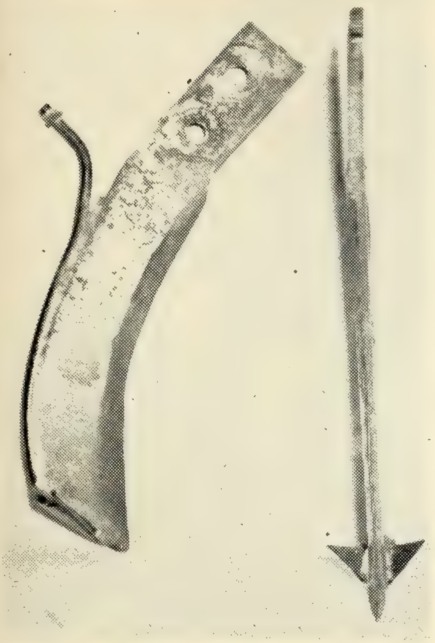
The order of increasing cost of devices for controlling the rate of flow of anhydrous ammonia is (1) needle valve and pressure gauge, (2) regulating valve and pressure gauge, (3) flowrator and cooler. and (4) pump and cooler. With numbers 1, 2 and 3 the setting of the needle valve is changed with changes in pressure to maintain a uniform rate of application; with number 4 no change in setting is required. All of the metering devices are very accurate with skilled operators; number 3 requires less operation skill than 1 and 2, number 4 still less when properly adjusted. Numbers 1 and 2 may find their greatest usefulness where farmers are doing their own work, while numbers 3 and 4 are probably more desirable for custom work; however, in skilled hands any of the metering devices is very accurate.

Even though very accurate metering may be obtained with metering systems 1 and 2, the rate of ammonia through them varies with the tank pressure and the valve gauge settings. For example, where it is desired to apply 300 pounds of anhydrous ammonia per hour through four 3/32-inch orifices, an orifice gauge pressure of 37 pounds per square inch is required with a tank pressure of 90 pounds per square inch, while an orifice gauge pressure of 52 pounds is required when the tank pressure goes up to 150 pounds per square inch. If a regulating valve maintained the orifice gauge pressure at 37 pounds, only 220 pounds of ammonia would be delivered as compared to the desired 300 pounds per hour when the tank pressure goes to 150 pounds per square inch.

Applicators

Anhydrous ammonia has proved to be slightly more efficient when applied 6 inches below where the seed are to be planted or 6 inches deep in side dressing than when the depth is 4 inches; however, good results are obtained at the 4-inch depth.

It should be borne in mind that anhydrous ammonia is a gas compressed to a liquid and handled under pressure. When the pressure is released it quickly evaporates into the air. When either anhydrous or aqua ammonia is applid to the soil it must be put into the soil and covered without exposure to the air to avoid the loss of ammonia. When ammonia is applied to the soil it moves until it comes in contact with sufficient clay and organic matter to take it up, and solids are formed which prevent its escape into the air. It is evident that if the ammonia comes in contact with a considerable volume of loose soil that it is



The addition of the point of a 12-inch sweep to an applicator increases the efficiency of the absorption of ammonia because more soil comes in contact with the ammonia.

more easily absorbed than if it is applied in a smooth narrow slit in compact soil.

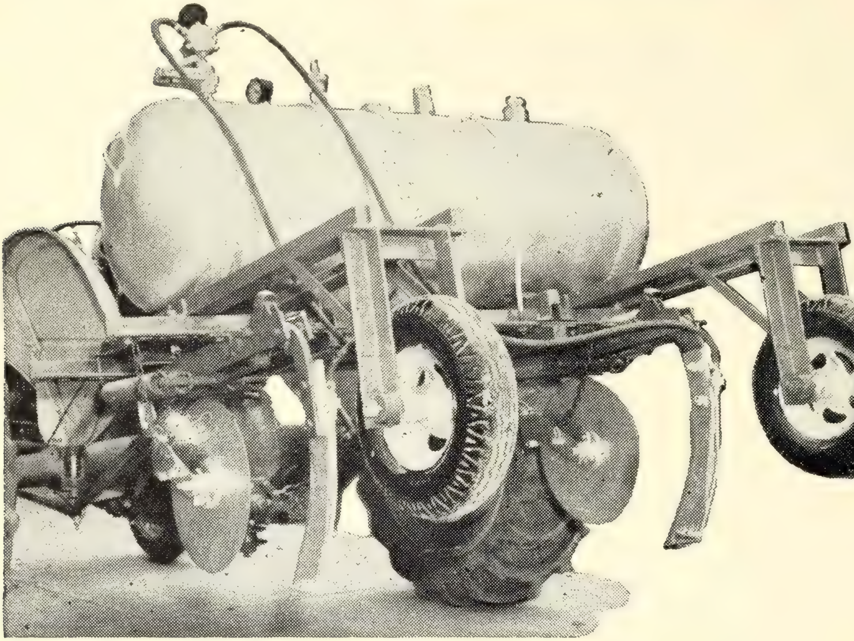
Almost any type of applicator is satisfactory for applying anhydrous ammonia in soils which have been broken, and which are friable and free of trash. The difficulty of applying ammonia increases as soils become less friable, more compact, and more trashy. The problem of sealing ammonia also increases as the rate of application per linear foot increases. The discussion of the applicators is made as if they were to be used under conditions where it is difficult to seal ammonia.

In most cases anhydrous ammonia applicators are put on cultivators instead of the feet. Some of the older cultivators are not strong enough to carry the applicators where the soil is extremely heavy and compact; however, it is reported that some of the newer models have sufficient strength. Where floating cultivators are used the applicator must have a point, or other additions, broad enough to enable it to take the ground. Where a machine is so constructed that weight or force can be applied to the applicator a broad piont is not needed to force it into the ground.

In order for an applicator to shed trash it must slope up and backward. If the point is too far forward, slipping in the holder, bending and breakage are increased. In practice ammonia leaves the applicator through small and large openings. The outlets may enter the opening made by the applicator or they may open against the unbroken soil as the applicator moves forward. In the latter case where the soil is extremely compact there is difficulty in getting sufficient ammonia through the openings. It appears that applicators will be more satisfactory when they open into the opening made in the soil, and there is no reason for the outlet being restricted or small.

In many cases the ammonia outlets in the applicators are not of uniform size. Where they are not of uniform size, the rate of application is different on each row. It is evident that if the rate of flow of water at a given head were determined for each applicator and stamped on the applicator that a farmer would be able to get applicators with uniform delivery of ammonia.

On soils which are not friable, the efficiency of the absorption and retention of ammonia by the soil is increased when an addition is put on the knife which opens a larger hole than where a straight knife is used. An illustration of an applicator foot which has worked very well is shown in this bulletin. The applicator wings on the bottom of the foot were made from the point of a 12-inch sweep. So far, the wings have been attached so that they come flush with the



This equipment was designed by engineers at the Mississippi Experiment Station for use in tung orchards. The curvature of the applicator facilitates shedding of trash; the broad point and the curvature enable it to take the ground.

rear of the applicator; however, it appears that attaching them so that they extend slightly to the rear of the applicator may be superior. The ammonia outlet may enter directly into the opening made by the applicator; however, opening to the side rather than straight down helps to prevent filling the outlet with soil on dropping it into the ground.

All applicators should be provided with a small break pin or a tripping device. Break pins are probably more satisfactory where there are few stumps, roots, or stones; where they are numerous spring trips are preferred. The number of springs required depends upon the size and length of the applicator as well as on the strength of the springs. In the tung area, where pine roots are numerous and the applicators used are relatively long, four Ford-cultivator trip springs are used on each applicator. There are, of course, other releasing devices.

Applicators should be hard-surfaced to reduce wear. The points of applicators depreciate due to wear much more rapidly than the rest of the applicator. The use of applicators with replaceable points could be more economical; these are not yet available.

Orifices

Orifices in the manifold are used to divide the ammonia for the different rows. For rates of application up to 100 pounds of ammonia per hour per orifice, 3/32-inch orifices give a uniform division of the ammonia; where higher rates are used larger orifices may be necessary. Where larger orifices are used than necessary, the flow to the individual applicators may be less uniform.

One anhydrous ammonia applicator is normally used per row, and there is no crop evidence to justify two applicators. In the case of listers and middle breakers, a number of whole rows and two or four half rows are formed, an applicator is necessary on each half row; the orifice for the half rows should have one-half the area of that for the full rows.

Difficulties in Cold Weather

With conventional equipment the rate of delivery of ammonia during cold weather is sometimes lower than desired. The rate of flow of anhydrous ammonia may be increased by:

1. Reducing constrictions in the line from the manifold to the outlet on the applicator.
2. Increasing the size of the hose to the applicator.
3. Increasing the size of the orifices.
4. Increasing the size of the hose and connections from the tank to the metering device.

The order of the importance of these changes in increasing the rate of flow of ammonia is probably the order in which they are listed.

Equipment for Applying Aqua Ammonia

Since the pressure exerted by a 30 percent solution of aqua ammonia should not exceed 10 pounds per square inch, the tanks for storing and applying it are made out of thin material. Even though the material from which gasoline tanks are made should be satisfactory, the heads should be convex so that they will withstand the pressure exerted. Flat-headed containers are unsatisfactory.

All tanks for handling aqua ammonia should have the following fittings:

1. Filling valve.
2. Pop-off valve set on 10 pounds pressure.
3. Bleeding valve.
4. Air inlet check valve.
5. Outlet valve and hose.
6. Glass indicator gauge.

All fittings should be made of iron or steel. Copper and brass fittings are not suitable because they are readily corroded by aqua ammonia.

A low pressure metering pump is the most satisfactory means of controlling the rate of application to the soil. The pump is driven from the axle of the equipment on which it is mounted, and a constant speed is not necessary. So far as the rate of application is concerned, when the pump is once calibrated correctly, it should operate accurately with little attention.

The pump recommended is a 20 DV Yale-Towne rotary-positive-displacement pump, with a variable-volume-manual control for quantities up to 1.5 gallons per hundred revolutions. The pump is driven from the axle of the machine on which it is mounted through a counter shaft which steps the speed up to 400 revolutions per minute. A 1 1/4-inch hose connects the pump to the supply tank. A fine screen should be placed over the hose outlet in the tank to keep trash out of the metering equipment. A 5- to 10-pound pressure-relief-discharge valve is put in the line after the pump to stop the flow of aqua ammonia through the pump when the equipment is not moving.

The manifold is connected to the pressure relief valve. The manifold, feed lines and applicators are the same as described above for anhydrous ammonia. The size of the orifices in the manifold for aqua ammonia may need to be increased where heavy rates of application are used.

A small air compressor may be used to build up pressure in the tractor tank if the tank has sufficient strength to withstand the pressure. A needle valve or regulating valve with orifices may be used to meter the aqua ammonia where compressors are used to build up the pressure in tractor tanks. Storage tanks are needed to withstand the pressure developed by compressors.

If aqua ammonia is exposed, ammonia is readily lost into the air. For this reason, the same care should be used in covering aqua ammonia as is necessary with anhydrous ammonia.

RECOMMENDATIONS

On the basis of experience with anhydrous ammonia the following recommendations are made. For preplanting application to row crops apply anhydrous ammonia 4 to 6 inches to the side of where the seed are to be placed. Up to 75 pounds of anhydrous ammonia (60 pounds nitrogen) per acre may be applied in the center of the bed if it is applied at least 4 inches below where the seed are to be placed. Higher rates should be applied to the side of seed on most soils.

Yields which reasonably may be expected without fertilizer and with the most profitable rate of fertilizer depend upon the soil. The amount of nitrogen (or other fertilizers) to be used should be based on the increase in yield expected above that which would be produced without fertilizer. In general, soils which are well drained 3 feet deep or deeper are capable of producing high yields. Those which are poorly drained often produce low yields.

1. **For cotton** apply anhydrous ammonia for normal needs within a month before and a month after planting. Pre-planting application is preferred. Make later applications where growth is unsatisfactory because of a lack of nitrogen. In side-dressing young cotton apply anhydrous ammonia 5 to 6 inches to the side of the plants; for larger plants apply at the edge of the root zone. On soils well adapted to cotton, apply one pound of anhydrous ammonia for each 8 pounds of increase in yield of seed cotton anticipated (one pound nitrogen for each 10 pounds of cotton). One pound of anhydrous ammonia may increase the yield 12 pounds of seed cotton under the best conditions or it may produce less than 8 pounds of seed cotton where soils and weather are unfavorable.

2. **For corn** apply anhydrous ammonia from one month before planting until the last cultivation. In side-dressing apply anhydrous ammonia 10 to 12 inches from young plants, and in the middles for larger plants. Apply 3 pounds of anhydrous ammonia (2½ pounds nitrogen) for each bushel increase anticipated. Leave a stand of 100 stalks of a good variety for each bushel of corn expected.

3. **For oats for forage** space applicators 18 inches apart. Apply anhydrous ammonia before planting. Apply 60 pounds of anhydrous ammonia (50 pounds nitrogen) per acre on soils which are high in nitrogen—those which produce 1200 pounds of dry forage per acre during the fall and winter months without nitrogen. Apply 120 pounds of anhydrous ammonia (100 pounds nitrogen) on those soils which are very low in nitrogen—soils producing less than 500 pounds of dry forage per acre during the fall and winter.

4. **For oats for grain** apply anhydrous ammonia in February on most soils. Space applicators 18 to 24 inches apart on heavy soils, and 24 to 32 inches apart on the lighter soils. Apply 1½ pounds of anhydrous ammonia (1 1/3 pounds nitrogen) for each bushel increase expected. Yields above 60 bushels per acre are not common.

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FENCES
For Bottomland Farms In the Delta

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
FRANK J. WELCH, Director
STATE COLLEGE MISSISSIPPI

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Fences for Bottomland Farms in the Delta

By L. C. MAISENHELDER and J. S. McKNIGHT[1]

The success of any fence depends on the posts. Their cost and the labor of setting them make up most of the price of the fence. The best way to make the investment in the fence last as long as possible, and to avoid the annoyance and expense of repairs, is to use durable posts. Means of securing such posts and of constructing fences suited to bottomland soils and weather conditions are described in this bulletin.

Sources of Posts

Bottomland farmers who want durable wooden fence posts can secure them in several ways: by getting them from species of trees whose wood is naturally durable; by purchasing posts treated with preservatives; or by treating the wood of local non-durable species to prolong its life. Steel posts are another alternative, but they are more expensive than wooden ones, and in some bottomland soils cattle push them over when the ground is wet.

Cypress, mulberry, eastern red cedar, mountain cedar, osage orange (bois d'arc), and black locust are the principal trees whose heartwood endures well in contact with the ground. All of the cedar and most of the osage orange posts are grown outside the bottomlands. There are a few black locust plantations in the Delta, but most posts of this species are cut in the uplands. Mulberry and cypress, which are native to the bottomlands, were the chief source of posts in the past, but the supply from these species has dwindled.

In all of these species, it is only the dark-colored heartwood that is durable. In judging a post from one of these species, therefore, the prospective buyer should picture it as it will appear after the light-colored outer ring of sapwood has rotted off. Only if it is then large enough will it give the service that should be expected.

Some pine posts treated with preservatives are now being sold in the bottomlands. If treating is properly done, such posts will last 15 years or more. The buyer should get a guarantee that the treatment was made with an effective oil-base preservative. Pentachlorophenol (commonly called penta) and coal-tar creosote are two good preservatives. The posts should have at least 6 pounds per cubic foot of a 5-percent solution of pentachlorophenol or the same weight of at least a 50-50 solution of creosote and fuel oil.

When the supply of posts from mulberry and cypress declined, many bottomland farmers turned to other native species, using them without preservative treatment. In fact, untreated posts are still used more than their durability warrants. Most of them have a life expectancy of between 1 and 5 years; even those from white oak heartwood seldom last beyond 7 years. While the first cost of such posts may be low, the need for frequent replacements makes them costly in the long run.

Many species of bottomland hardwoods, however, will take preservative well. In 1941 about six miles of fence (about 528 posts per mile) was constructed along the boundary of the Delta Experimental Forest, near Stoneville, Mississippi. The posts were native Delta species treated locally by the hot and cold bath method, described later, with a 50-50 mixture of creosote and fuel oil. After nine years of service, a check of 335 sample posts shows that only 26 posts had failed because of decay, and fourteen of these were from species not recommended for treatment. Subsequent study shows that bottomland species will absorb pentachlorphenol as well as they do creosote.

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[1] Delta Branch, Southern Forest Experiment Station Forest Service, U. S. Department of Agriculture in cooperation with Mississippi Agricultural Experiment Station.

At present there are no commercial treating plants in the Delta, but posts can be treated on the farm by methods described in this bulletin. Home treatment provides for the amounts and sizes of posts needed and assures that the proper type and amount of preservative is used. If farm labor can be used during slack seasons, the posts can be turned out for less than if they had to be purchased. When the posts are cut from trees undesirable for other purposes, post-making is a means of improving the farm woods.

Cutting and Preparing Posts For Treatment

Sapwood of oak, pecan, hickory, sweetgum, honey and water locust, and hackberry generally is the easiest to treat, but most of the common bottomland species treat well. The only exceptions are cottonwood and willow, which take preservative less uniformly and less readily than all the others.

Round posts are best. They are encircled by sapwood, which takes up preservatives more quickly and readily than heartwood does. Split posts may be used if they have only a small volume of heartwood. Service tests on heartwood posts of most bottomland species have shown only partial decay over a period of 9 years, but the penetration of the preservative was not so uniform or deep as in sapwood posts, rotting is futher advanced, and earlier failure seems certain.

About 6½ feet is the minimum length for a good line post for a bottomland fence. Top diameter of line posts should be 3½ to 5 inches. Larger posts waste preservative. Corner, gate, and pull posts should be at least 7½ feet long and 5 inches in top diameter. Braces should be 9 feet long and 3 to 5 inches in diameter at the small end.

Post cutting can either improve or butcher the farm woods. The posts should be cut from the least desirable trees—those damaged by fire, wind, or ice; small trees too misshapen or crowded to grow to lumber logs; or trees of species that are not easily marketable. Weeding and thinning the forest in this manner rapidly improves the value of any woodland. There is always plenty of post material in the average bottomland forest.

Cutting and peeling posts: Posts may be cut at any season. They must be peeled, however, and peeling is easiest between spring and July. Sawing is generally a better means of felling the trees and cutting the posts than chopping is. It is easier to cut the posts to uniform length with a saw and sawed posts usually make a neater looking fence.

The posts can be cut where the tree is felled, limbed, and topped, or the tree can be skidded full length to a central point. Bunching the tree lengths makes post cutting and peeling more efficient, and it saves the trouble of finding and collecting the individual posts for loading or stacking.

Peeling is the most tedious part of postmaking, but unless all of the bark is removed down to the solid wood, the post will not take preservative as it should. The bark of some species, as red oak, is very tenacious except in early spring. Particular care must be taken to remove the corky inner layer, which seems to be almost a part of the wood itself. To avoid an increase in the tendency of the bark to stick to the stem, peeling should be done within a day after the tree is cut.

In the spring, when the bark is loose, the posts can be peeled with an ax or bark spud. The old hoe and shovel (figure 1) are home-made bark spuds that are useful when the bark is not tight.

The hooked bark spud can also be used to strip the bark during the spring. When spuds are used, it is sometimes easier to peel the tree trunk before it is cut into post lengths. Generally, the safest and most efficient way of hand peeling, in any season but spring, is with the special 16-inch draw knife. A rack or sawbuck should be constructed to hold the post at waist height as it is being peeled.

Barking machines may be used very profitably where the size of the job warrants the expense. Inexpensive machines of this type cannot, however, be relied on to do a thorough barking job on hardwoods at all seasons. For descriptions of barking machines currently in use, see "Fence Post Barking Machines in the South," by Mark M. Lehrbas. Copies of this bulletin may be had by writing to the Southern Forest Experiment Station, New Orleans.

Peeling may be done either in the woods or at the treating plant. The advantage to peeling in the woods is that the posts will be more likely to be peeled soon after cutting. When cutting is done during the winter, it is usually necessary to peel and stack the posts in the woods until the ground dries out enough to permit hauling.

Stacking posts: The stacking place should be well drained, free from weeds and debris that prevent free circulation of air about the posts, and preferably near the treating plant. Species which require different schedules of preservative treatment must be stacked separately. Stacks may be as high as desirable, but should always be started on a foundation which will place the bottom of the stack at least a foot above the ground. The method of piling illustrated in figure 2 affords enough air space to assure rapid drying and to prevent decay in the middle of the stack.

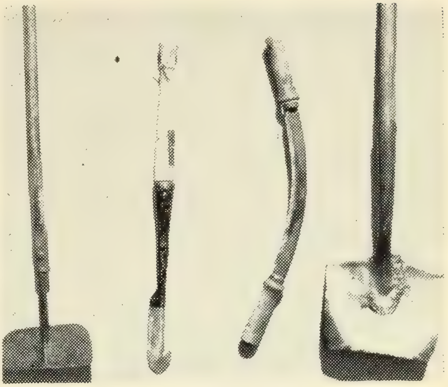

Figure 1. Post peeling tools—old hoe, hooked bark spud, drawknife and old shovel.

Well-stacked posts piled in this manner dry in two or three months of warm, dry weather, but require at least four months during the winter. When sufficiently dried, a post will be much lighter than when green, and usually will be considerably checked or cracked. It is very important that checking be complete before treating. To this end, very large posts (5 inches and larger) should be dried an extra month. Dried posts should be free from rain for at least three days before they are treated with preservative.

Treating Posts With Preservative

Three methods—hot-and-cold bath, cold soaking, and pressure treating—are in common use for getting preservative into fence posts. Pressure treating is a technical, engineering operation that requires an expensive plant best adapted to treating large quantities of posts for the market.

Of the other two methods, cold soaking is the simplest and requires the least initial cash outlay. Well-seasoned posts are piled in a tank of preservative and allowed to soak until they have taken up the required amount of chemical. Cold soaking is the slowest method of treatment but is suitable where requirements for posts are small or are spread over a

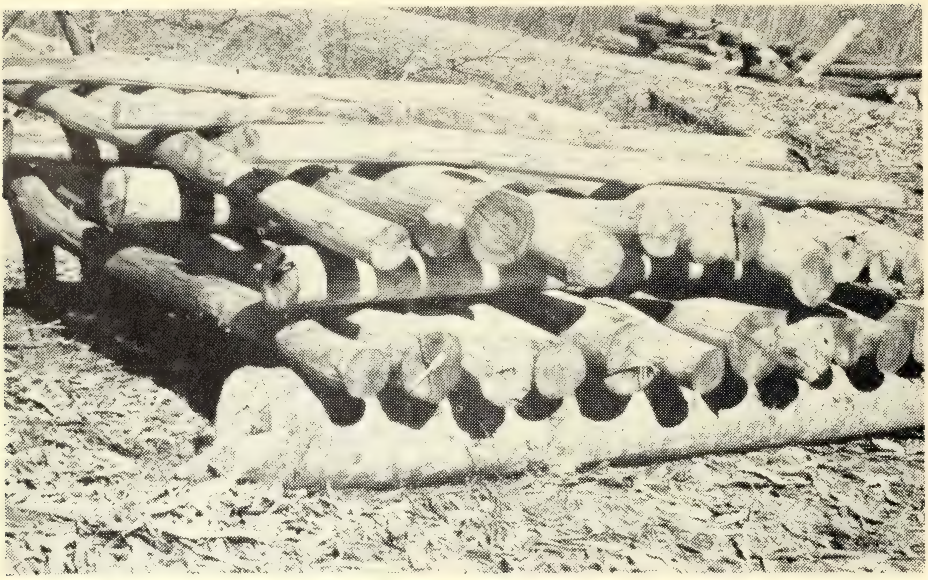

Figure 2. Posts piled in this way get enough air for rapid drying. The pile can be made as high as is convenient.

long period. The method will not be described here, as complete instructions are given in "Treating Fence Posts with Pentachlorophenol-Fuel Oil Solutions Using the Cold-Soaking Method," by D. A. Kulp, published as Circular 141 of the Mississippi Agricultural Experiment Station, State College, Miss.

The hot and cold bath method is the most effective of the open-tank methods for treating the large numbers of posts commonly needed on bottomland farms. The posts are first heated in a tank of hot preservative. When most of the air and remaining moisture has been driven from the cells of the wood, the posts are immediately submerged in a tank of cool preservative. The partial vacuum created in the wood cells by the cooling and contraction of the remaining air assists in pulling the preservative into the pores of the wood. From 75 to 95 percent of the absorption takes place in the cold bath.

The hot and cold bath system is rapid and thorough, and can be used on all bottomland species (tests in the Delta show that cottonwood and willow cannot be treated as effectively as other species). The chief disadvantage is that the cash outlay for equipment is greater than for the cold soaking method. The plant can usually best be financed as a cooperative project between farms or as a small scale commercial operation.

Plant design and equipment: A very satisfactory plant for hot-and-cold bath treating was built at Stoneville, Miss. It consists of two 1,200-gallon tanks, each 18 feet long, made by cutting a large boiler in two. The tanks are placed end to end and there is a working platform and guard rail around each. A chain hoist on an overhead trolley enables prompt transfer of posts from the hot to the cold tank. Long tanks are desirable for treating poles, bridge timbers, sills, planks, and other material. If only posts or other short material is to be treated, however, large tanks are unnecessary except as a means of speeding production.

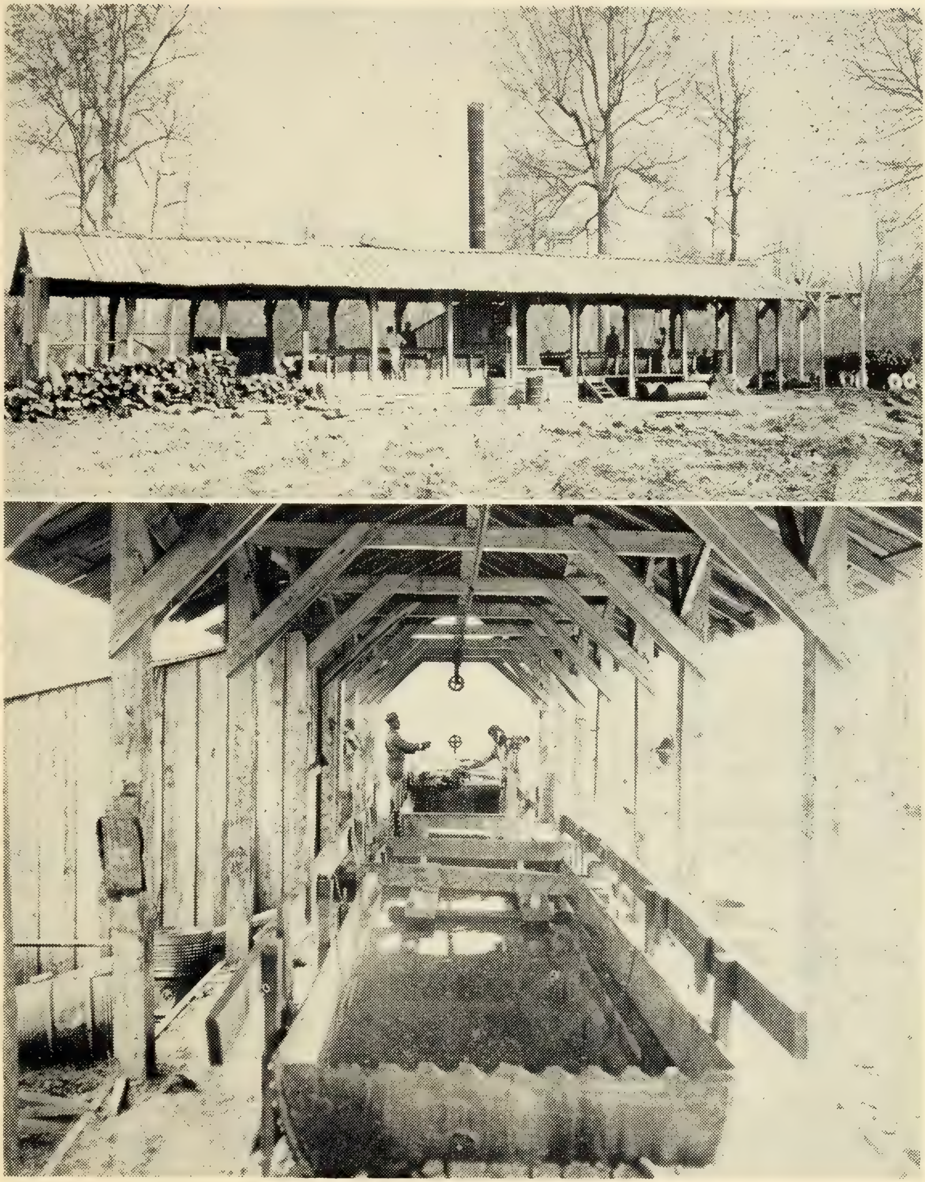

Figure 3. The hot-and-cold bath treating plant at Stoneville. This plant is suitable for use with both creosote and pentachlorophenol. Two laborers with part-time supervision can treat about 300 posts per day. Hot tank is in foreground of lower view.

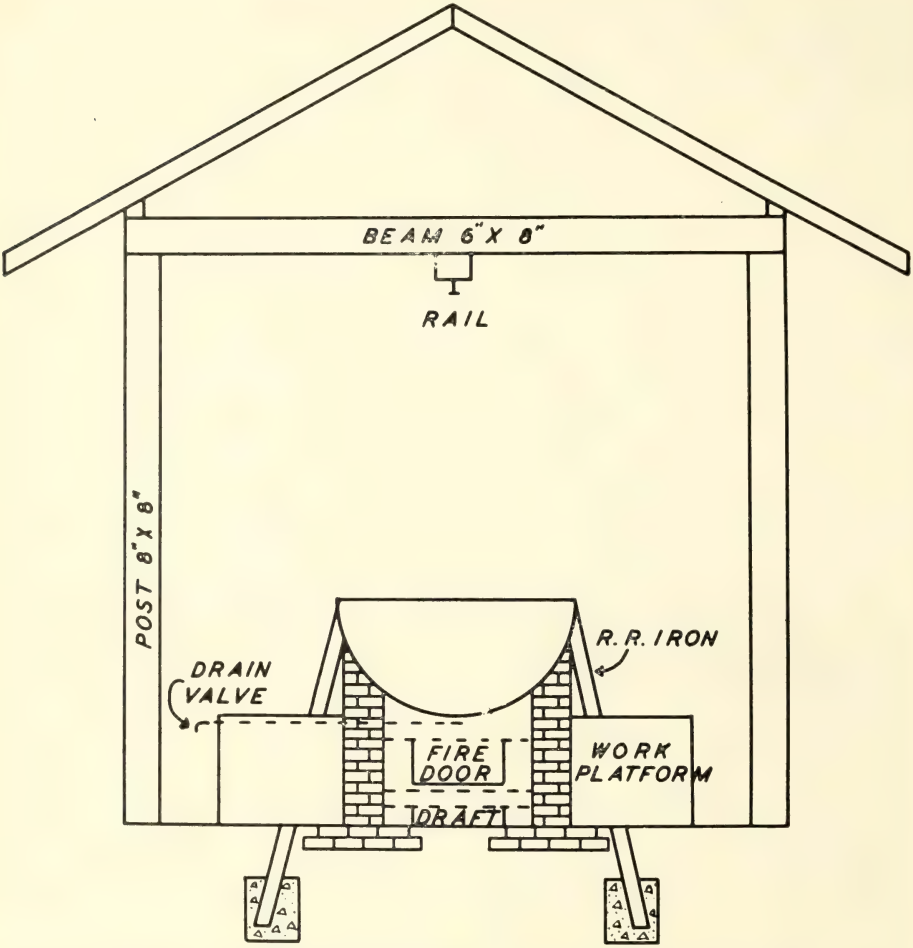

Figure 4. Diagram of hot tank installation for hot and cold bath treatment.

Figures 3 and 4 show the chief features of the plant, which is adapted to the use of both creosote and pentachlorophenol. A Dutch oven runs the length of the hot tank—the fire door is at one end and the chimney at the other. A fire just inside the door heats the entire tank evenly. Dry and green wood are used in combination to get a steady heat. Natural gas or butane could also be used. An exposed flame, however, causes serious risk from fire, and the safest method would be to heat the tank with steam coils from a boiler at some distance from the plant.

Pure creosote was used in the hot tank for safety and to reduce evaporation, the cold tank solution was made up of equal volumes of number 2 Diesel fuel and creosote. In any plant, tanks must be covered to keep rainwater out of the preservative and as a safety measure for people and animals. Water causes hot creosote to froth and boil over, thus creating a fire hazard.

Before the posts are submerged, they should be chained into bundles for ease in handling. A bundling rack similar to the one shown in Figure 5 greatly facilitates chaining, which must be done securely as the oily posts become very slippery. A heavy wooden frame hinged to the tanks is used to force the bundles of posts completely under the solution (Figure 6).

Tank schedules: Next to seeing that the posts are dry and completely free of bark, the most important phase of treating is the length of time the posts are kept in the hot and cold tanks. The following recommendations are made after considerable investigation and experience at Stoneville. The schedules assume that preservative in the hot tank will be kept at an even 220°F; the temperature should be checked frequently with a thermometer.

Different species vary a little in the time they require but when creosote solutions are used the species may be placed in the three general groups shown in table 1. The schedules in this table are designed to produce an absorption of 6 to 8 pounds of a 50-50 solution of creosote and fuel oil per cubic foot of wood in line posts averaging 3 to 5 inches in diameter at the small end. For larger posts, the hot tank schedule should be increased by 45 minutes.

Pentachlorophenol requires slightly longer times than creosote. The schedules in table 2 gave satisfactory absorption at the Delta Branch plant though service tests have not yet been in long enough to be conclusive. The schedule is for "4-1" concentrate as delivered from a chemical supply house. For the hot tank, every drum of pentachlorophenol was

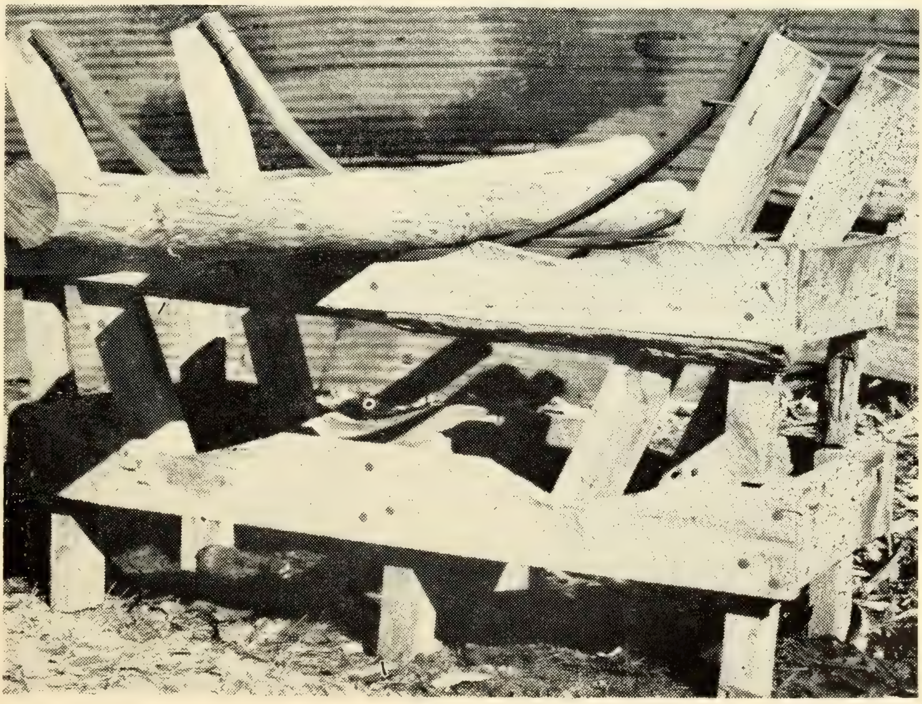

Figure 5. Post-bundling rack. The two bowed irons on which the posts are laid conform to the curve of the bottom of the treating tanks.

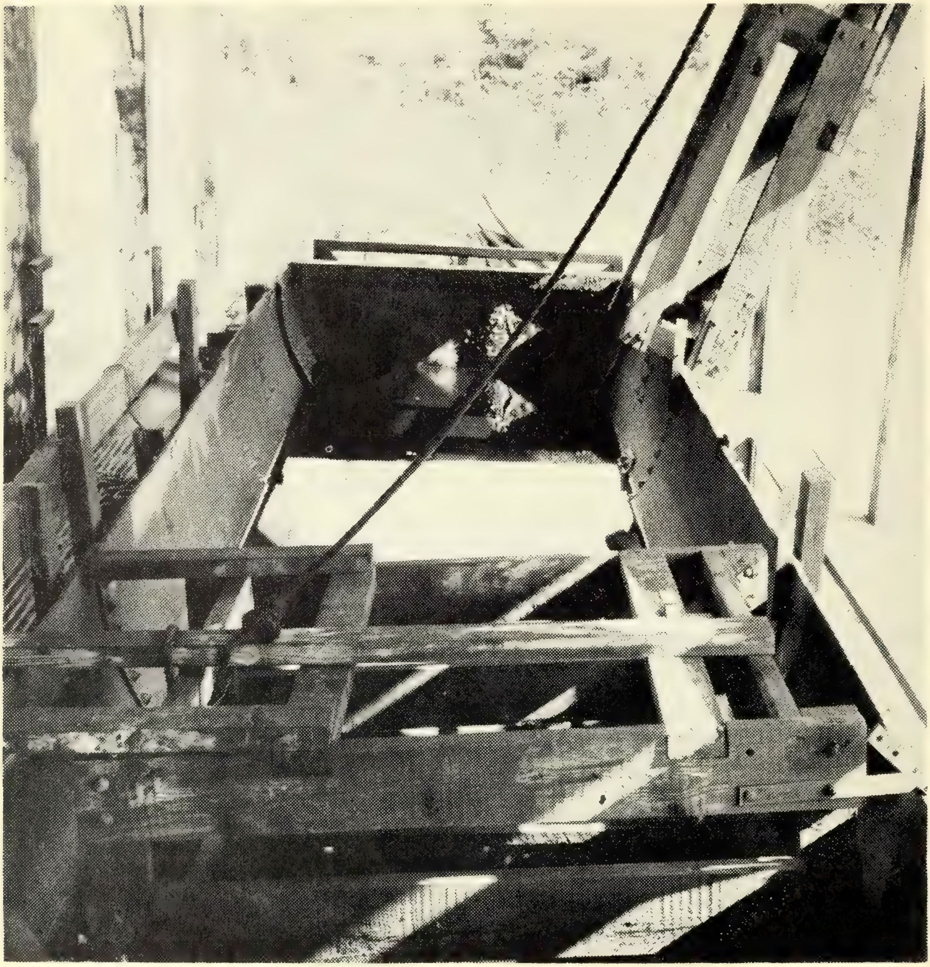

Figure 6. Heavy wooden frames, hinged to the sides of the tanks, are dropped on the bundles of posts to keep them submerged in the preservative.

diluted with four drums of oil with a high flash point (a high flash point is safest with an open flame, and also avoids excessive evaporation). In the cold tank, each drum of pentachlorophenol was diluted with four drums of number 2 Diesel fuel oil. When any pentachlorophenol is purchased, the seller should recommend the exact type and amount of oil to be used as a diluent.

With both pentachlorophenol and creosote, particular care should be taken to see that the cold tank schedules are followed closely. The hot tank schedule can be increased somewhat without seriously affecting the treatment, but it should not be decreased.

However, because of inevitable variations in the temperature of the cold tank, and in the dryness, size and heartwood content of the posts, it is wise to check the actual effect of the recommended schedule. Too much absorption increases the cost unnecessarily, while absorption

Table 1. Recommended hot and cold bath schedule for treating with creosote solution.

Species group	Hot bath	Cold bath
	Minutes	
1— Soft elm Honey locust Oaks Sweet gum Hackberry	90	15
2— Maple Willow Cottonwood Cypress	90	20
3— Pecans Persimmon Ash Rock elm	105	60

Table 2. Recommended hot and cold bath schedule for treating with 5-percent pentachlorophenol solution.

Species group	Hot bath	Cold bath
	Minutes	
1— Soft elm Hackberry Oaks Sweet gum	90	25
2— Pecans Ash Persimmon Rock elm	120	60

of less than 5 pounds per cubic foot may reduce the life of the post.

The easiest way to check absorption is to determine the weight of a bundle of posts before and after treating, and then compute the weight of the solution absorbed per cubic foot of wood. Wood volume in posts of various sizes is given in table 3.

With either chemical, the problem with species in the first group will likely be to hold the absorption to 6 to 8 pounds; it may turn out that the recommended cold bath schedules for these species should be reduced. With species in the last group the problem will be to get the necessary minimum absorption. For equally good treatments, large posts will naturally take up somewhat less preservative per cubic foot of wood than small ones.

When the posts have been in the hot tank for the required time, they should be submerged in the cold tank as rapidly as possible, lest the pores refill with air instead of preservative. When the posts come out of the cold tank they should be suspended over the tank until excess solution has drained off. They are ready to use as soon as they are dry enough to handle. If they are not to be used soon, they should be stored under some sort of cover.

Cost of Treating Posts

The figures in table 4 were obtained in 1950 from the treatment at the Stoneville plant of about 2,000 bitter pecan, oak, sweetgum, and white elm posts. All posts were round. They averaged about 3.5 inches in diameter at the small end, and the average absorption of preservative was 6 3/4 pounds per cubic foot of wood. Treating was done by labor supplied by a farmer. The operation was very efficient and little reduction in the cost per post seems possible except through lower wage rates, and by purchase of the preservative in large amounts.

The cost of building a hot-and-cold bath treating plant will vary with the number of refinements that are included. Unless much of the material is already on hand, the simplest design will cost about $2,000, if farm labor is used for its construction. Tanks for storing wholesale quantities of preservative would add to the initial investment.

Fence Construction

The following pages touch on important points in fence construction that are frequently neglected. Fence builders who plan to apply for PMA benefits should procure a copy of the latest official specifications.

Setting the posts: Holes may be dug by hand, or more rapidly, with a mechanical digger attached to a farm tractor. They should be two feet deep for 6½-foot line posts and three feet deep for 7½-foot pull and corner posts.

Line posts should be set 10 feet apart from center to center, brace posts should be 8 feet from each corner post or pull post (Figure 7). The posts can be kept at uniform heights above the ground by checking with a 4½ foot stick as they are set. If the posts are set in the winter, tamping the soil used to fill the holes is unnecessary unless the site is very well drained. The dirt should be piled up above the normal ground level, however, to allow for settling. Posts set in dry seasons should be tamped. Pull posts should be set every 250 feet for woven wire fences and every 800 feet for barbed wire fences.

For protection against lightning, every twentieth post should be grounded by

Table 3. Volume of round fence posts

Average diameter inside bark at mid-point (inches)	Length in feet					
	6	6 1/2	7	7 1/2	8	10
			Cubic feet			
2.0	.13	.14	.15	.16	.17	.22
2.5	.20	.22	.24	.26	.27	.34
3.0	.29	.32	.34	.37	.39	.49
3.5	.40	.43	.47	.50	.53	.67
4.0	.52	.57	.61	.65	.70	.87
4.5	.66	.72	.77	.83	.88	1.10
5.0	.82	.89	.95	1.02	1.09	1.36
5.5	.99	1.07	1.16	1.24	1.32	1.65
6.0	1.18	1.28	1.37	1.47	1.57	1.96
6.5	1.38	1.50	1.61	1.73	1.84	2.30
7.0	1.60	1.74	1.87	2.00	2.14	2.67
7.5	1.84	1.99	2.15	2.30	2.45	3.07
8.0	2.09	2.27	2.44	2.62	2.79	3.49
8.5	2.36	2.56	2.76	2.96	3.15	3.94
9.0	2.65	2.87	3.09	3.31	3.53	4.42
9.5	2.95	3.20	3.45	3.69	3.94	4.92
10.0	3.27	3.55	3.82	4.09	4.36	5.45

Table 4. Cost of fence posts and preservation, 1950

Operation	Quantity	Cost
		Dollars
Stumpage, harvesting, peeling and hauling to plant[1]	2,000 posts	240.00
10-1 pentachlorophenol	100 gallons	220.00
Diesel fuel solvent	810 gallons	109.00
Heavy oil (hot tank solvent)	180 gallons	48.60
Firewood (stumpage)	4 cords	6.00
Labor (except harvesting posts)[2]		142.00
Treating plant rental		30.00
Total		795.60

Cost per post—39.8 cents

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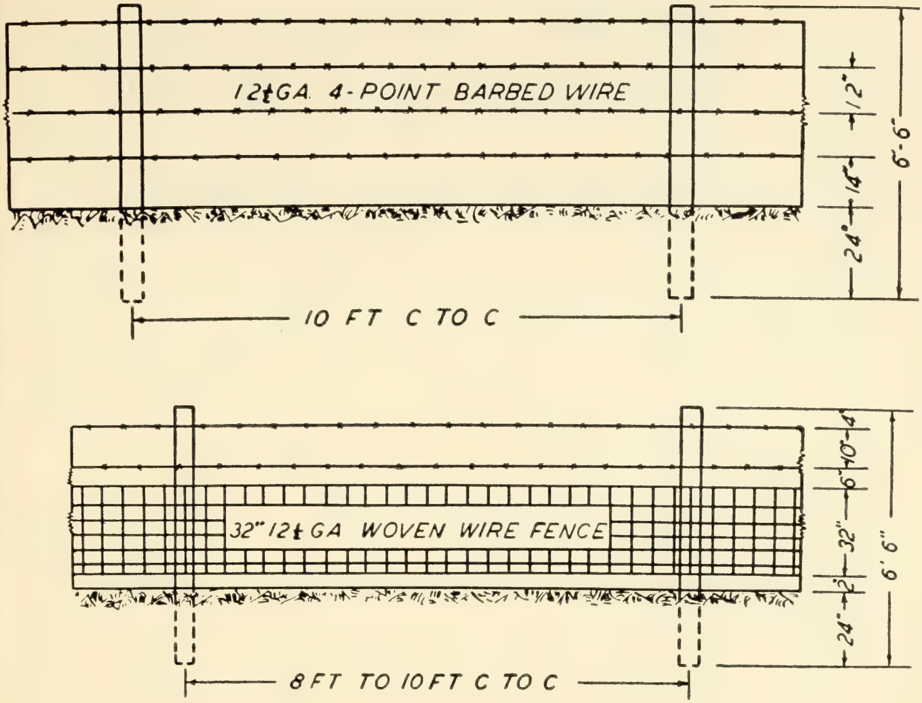
[1] This operation actually cost the farmer only 9c per post instead of 12c since he had his own timber and made no charge for hauling to the plant.

[2] The labor charge was at the 1950 prevailing hourly rate for plantation labor in the Mississippi Delta.



NOTE
1950 PMA SPECIFICATIONS CALL FOR STRAND
OF BARBED WIRE BETWEEN GROUND AND
WOVEN WIRE

Figure 7. Cattle and hog proof fences.

stapling a piece of No. 9 wire from the top to the bottom, between the fence wire and the post. At least three complete turns should be taken under the bottom of the post.

Bracing. Although wood is satisfactory, corner posts and their bracing are often made of iron pipe or railroad steel set in concrete. Though costly, this is a very desirable practice.

If wood corner posts are used, they should be set on concrete and braced in two directions. Figures 8 and 10 show two methods of bracing corner posts. These corner posts should be notched to take the end of the brace, and each brace should be fastened to the post with two 40-penny nails. In addition, a wire brace should be run from the base of the corner post to the top of each adjacent brace post. The wire brace should consist of four strands of No. 9 galvanized wire, with two strands passing on each side of the wood brace and all strands twisted together to form a taut tie and brace. Pull posts and posts at the end of fences (as at slough or drainage ditch crossings) should be braced to the adjacent post in the same way.

On uneven ground, the wire tends to pull up posts set in hollows. Pull-outs can

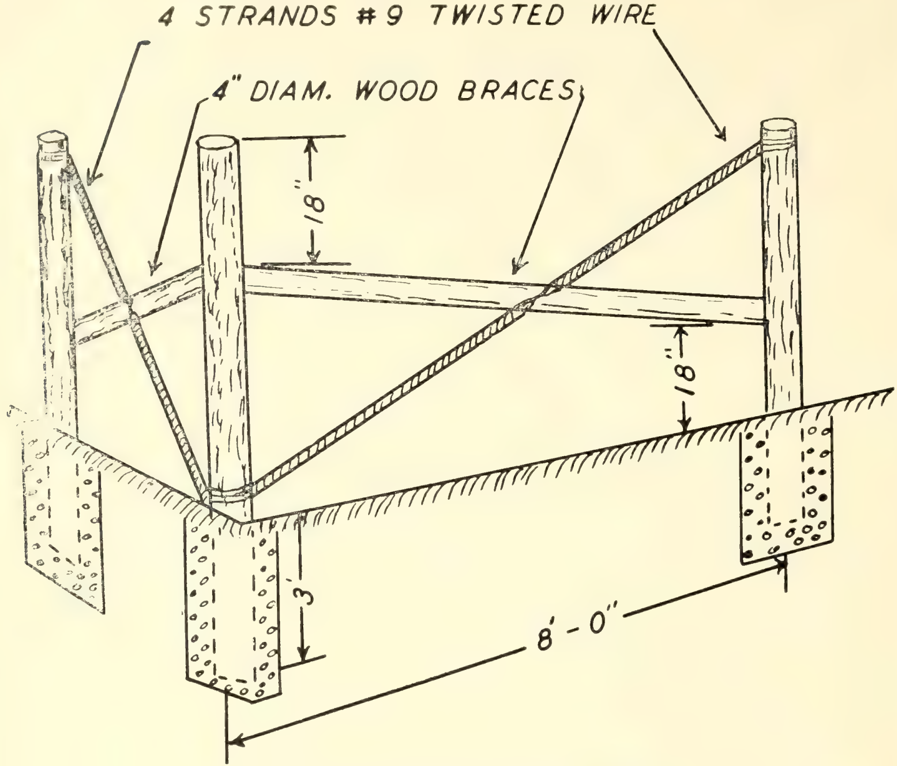


Figure 8. A method of bracing for fence corners.

be prevented by nailing a piece of 2 x 4 material, 2 feet long, at right angles to the length of the post and a few inches from the lower end. The cross-pieces should be treated with preservative. Figure 9 shows several ways of fencing streams and ditches that cross the fence line.

Untreated wood exposed in notching posts and cutting braces to fit should be thoroughly daubed with a concentrated solution of the preservative before the braces are finally put in place. Any holes bored in gate posts should likewise be filled with a concentrated preservative.

Stringing the wire. All wire should be fastened to the post on the side from which the stock is likely to come. With some of the harder species of wood, notably osage orange, it may be necessary to wire the fencing to the post, for it is often impossible to drive staples into the dry wood. Stapling in pecan and oak, species likely to be widely used for posts, is rather difficult but can be done. Other post species recommended for treatment take staples about as easily as pine. Stapling should be done with 1-1/8 inch galvanized staples. Five staples per post are sufficient for 32-inch woven wire, and eight per post will hold 47-inch wire.

When the wire is unrolled, the bottom strand should be next to the post, to make stretching easier. If a tractor is available, stretching woven wire is greatly facilitated, but care must be taken not to exert strain enough to displace corner or pull posts. Barbed wire should never be stretched with a tractor, because there is great danger that the wire will break

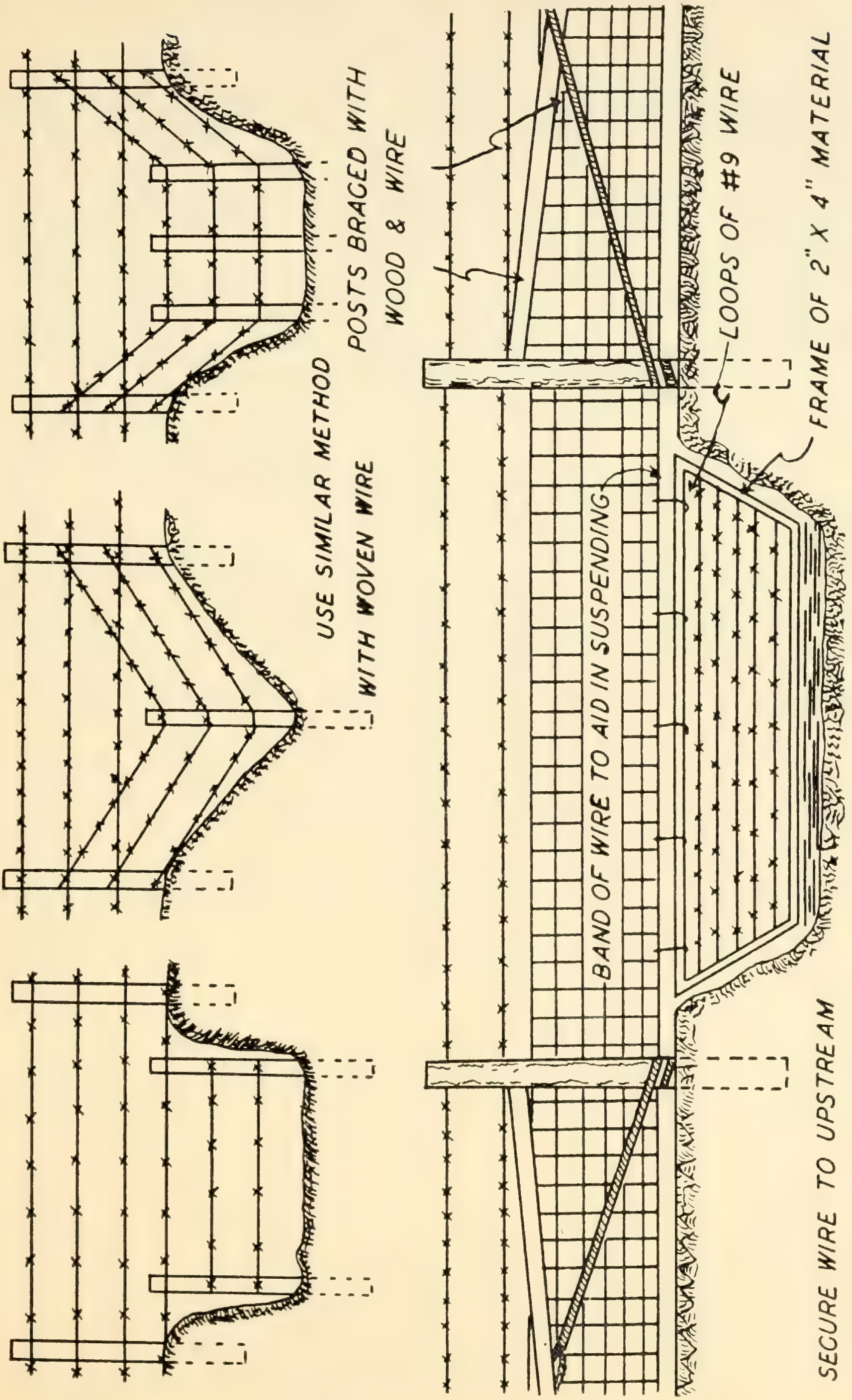

USE SIMILAR METHOD
WITH WOVEN WIRE
POSTS BRACED WITH
WOOD & WIRE
SECURE WIRE TO UPSTREAM
SIDE OF SWINGING FRAME
BAND OF WIRE TO AID IN SUSPENDING
LOOPS OF #9 WIRE
FRAME OF 2" X 4" MATERIAL

Figure 9. Methods of fencing unusual depressions along fence line.

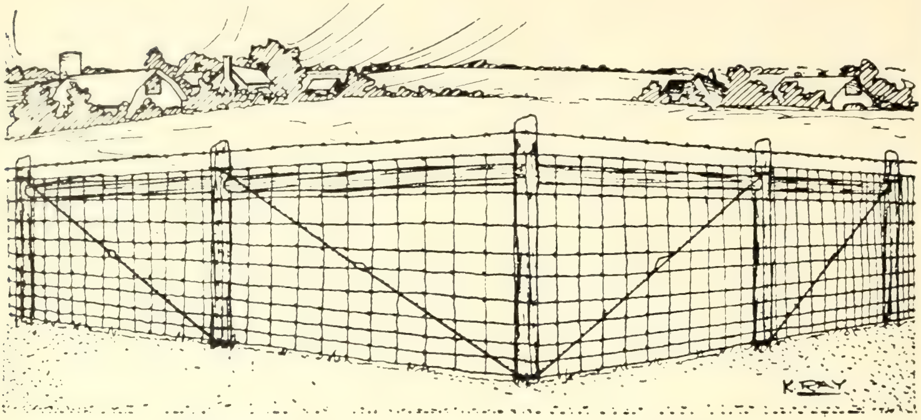


Figure 10. Another method of bracing corner posts.

and injure the tractor driver or other men working near the fence.

Usually it is best to avoid stretching wire when the ground is wet and soft. At such times the posts, unless they have been set for some time, are easily pulled out of plumb or yanked out of the ground.

Estimated Fencing Costs

The figures in table 5 are given only as a close estimation of the cost of constructing a fence in the Yazoo-Mississippi River Delta. They will generally apply in most large bottomland areas.

Table 5. Materials and costs per mile of fence[1]

Item	Using hand digger		Using tractor digger	
	Amount	Value	Amount	Value
		Dollars		Dollars
FOUR-STRAND BARBED WIRE				
Wire (12½ gauge)	16 rolls	136.00	16 rolls	136.00
Posts (treated)	528 posts	264.00	528 posts	264.00
Staples	24 lbs.	2.40	24 lbs.	2.40
Labor				
Digging holes	112.6 hrs.	39.41	16.4 hrs.	8.20
Other	51.2 hrs.	17.92	51.2 hrs.	17.92
Tractor				
Hauling	2.5 hrs.	1.75	2.5 hrs.	1.75
Trailer	2.5 hrs.	.16	2.5 hrs.	.16
Digging	----	—	8.8 hrs.	6.16
Total Cost		461.64		436.59
32" WOVEN WIRE				
Woven wire (12½ gauge)	16 rolls	260.00	16 rolls	260.00
Barbed wire (12½ gauge)	8 rolls	68.00	8 rolls	68.00
Posts (treated)	528 posts	264.00	528 posts	264.00
Staples	34 lbs.	3.40	34 lbs.	3.40
Labor				
Digging holes	112.6 hrs.	39.41	16.4 hrs.	8.20
Other	109.6 hrs.	38.36	109.6 hrs.	38.36
Tractor				
Hauling	2.9 hrs.	2.03	2.9 hrs.	2.03
Trailer	2.9 hrs.	.19	2.9 hrs.	.19
Digging	----	—	8.8 hrs.	6.16
Total cost		675.39		650.34

[1] Adapted from "Possible Land Use Alternatives, Yazoo-Mississippi Delta." Delta Council, Stoneville, Mississippi, 1949. Cost of fence posts has been changed from 35 cents per post to 50 cents per post, which is a conservative estimate of the average market price in 1950.

BULLETIN 484 SEPTEMBER, 1951

Marketing Mississippi Delta Cotton

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
CLAY LYLE, Director
STATE COLLEGE MISSISSIPPI

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MARKETING MISSISSIPPI DELTA COTTON

An Analysis of the Channels of Distribution, and of Marketing Services and Charges, 1949-50

By

Chester M. Wells, Jr., and William A. Faught[1]

Individual producers usually market cotton in small lots of mixed grades and staples while buyers for textile mills purchase relatively large lots of even-running grade and staple. This marked difference in producer sales and textile mill purchases gives rise to the complex merchandising system which exists today. In moving through this system the marketings of individual producers are combined into larger and larger lots until finally assembled into even-running lots, usually of 100 bales, of the same grade and staple. This assembling is necessary for economical transportation and also because textile mill spindles are set to handle raw cotton in only a limited quality range. In order to operate efficiently, mills must spin cotton of relatively uniform quality.

The process of moving a bale of cotton from the gin platform to the textile mill involves: (1) the physical movement from the gin to the mill and (2) the changes in ownership, through the transfer of bonded warehouse receipts, between the time it is sold by the producer and is bought by the spinner. This report will deal primarily with the latter of these operations, referring to the physical movement only to the extent that charges or costs of physical handling appear in the operation of merchandising firms. Its purpose is to analyze the changes of ownership involved in moving a bale of cotton to the textile mill, to determine the services performed by the different types of handlers in Delta markets, and to determine the costs or charges which occur in the marketing process.

Scope and Method

Early in 1950 a list was compiled of resident cotton buyers or handlers in the eleven Delta counties (Tunica, Coahoma, Quitman, Bolivar, Sunflower, Leflore, Washington, Humphreys, Sharkey, Issaquena and Tallahatchie). Handlers on this list were stratified by major type of operation and by volume handled. All larger handlers were included in the sample and smaller handlers were sampled in proportion to the volume handled. Table 1 shows, by size group, the number of handlers in the Delta and in the sample. In the summer of 1950 the 36 handlers in the sample were interviewed and schedules completed. All data are for the 1949-50 season. The sample data were expanded by the application of the reciprocal of the sampling rate.

The enumeration revealed that the following types of handlers operated in Delta Markets:

(1) **Factors,** who do not take ownership to cotton but sell for producers and other types of handlers and receive a brokerage fee for selling.

(2) **Country buyers,** who purchase cotton from producers and other types of handlers and sell to other local market handlers or to handlers in other markets.

(3) **Country shippers,** who purchase cotton from producers and other types of handlers, assemble into even-running lots and ship to domestic or export mills.

(4) **Salary buyers,** for central merchants who purchase cotton for central market merchants and receive a salary for their work.

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Table 1.—Number of handlers in the Delta and in the sample, by size groups, Mississippi Delta, 1949-50.

Number of bales handled	Total number of handlers	Number of handlers in sample
500 - 4,999	49	2
5,000 - 9,999	39	4
10,000 - 19,999	41	10
20,000 - 34,999	19	9
35,000 - 49,999	7	7
50,000 - 99,999	3	3
100,000 and over	1	1
Total	159	36

(5) **Commission buyers,** in Delta markets represented central merchants, mill market shippers, country shippers, and mill buyers. They purchased cotton from producers and other types of handlers and received a commission for each bale purchased.

Most handlers found it necessary, or to their advantage, to operate in several ways. Factors sometimes found it advantageous to operate as country buyers or shippers, buying cotton for their own account if sellers insisted that they do so, if other buyers were not available, or if they believed that cotton could be handled profitably at a price equivalent to the highest bid of other buyers. Similarly, country buyers sometimes were able to sell some cotton profitably to buyers located in mill markets. Country shippers frequently have odd-lots of cotton that cannot be assembled for shipment to mills. This cotton is usually sold to local or central market buyers. Although handlers were classified, for sampling purposes, by the major type of operation in which they engaged, data for each handler were tabulated according to each type of operation in which he engaged in order to show more clearly the differences between types of buyers in services performed and costs incurred.

Source of Receipts and Distribution of Sales

The data reveal that local market handlers merchandised a total of 2,183,000 bales of cotton in the 1949-50 season. Table 2 shows the sources from which each type of handler received cotton.

That factors are highly significant types of handlers in the merchandising system is readily apparent from the table. Producers and other types of handlers patronize factors more than they do all other types of handlers combined. Slightly less than three-fifths of the cotton marketed by producers was sold across factor's tables, and almost three-fifths of the cotton purchased by other types of buyers was bought there.

Even though first handlers reported handling 2,183,000 bales of cotton, only 1,231,000 bales actually entered the Delta markets. This latter figure was obtained by adding the 1,105,000 bales of producer cotton to the 126,000 bales entering the market from the factors and country buyers located outside the Delta.[2] The difference between 2,183,000 bales and 1,231,000 represents cotton that passed through the hands of more than one local handler.

The average turnover per bale can be determined by dividing the number of bales entering the market into the total number of bales handled by all types of handlers in the market. This average turnover revealed that on the average, bales were handled 1.8 times while passing through local markets. Emphasis should be placed on the fact that this figure applies only to transactions in the local market, and that cotton going to central markets or to mills usually passed through one or more additional handlers after leaving Delta markets.

The information contained in Table 3 reveals that, of the 1,231,000 bales that entered the markets, 49 per cent went directly to mill markets (6 per cent to mill market shippers and 43 per cent to mill buyers, direct or through brokers in mill markets) and 51 per cent went to central market

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[2] Cotton production in the eleven Delta counties as reported by Bureau of the Census, totaled 834,093 bales in 1949. Significant proportions of the cotton produced in the North Delta by-passed local markets and were sold in Memphis. It is estimated that approximately 300,000 bales of producer cotton entered Delta markets from surrounding counties in Mississippi and from across the river in Arkansas and Louisiana.

Table 2.—Source of receipts of cotton by indicated types of handlers, Mississippi, Delta, 1949-50.

Type of handler	Source of receipts				
	Producers	Factors	Country buyers	Commission buyers	Total
	1000 bales	1000 bales	1000 bales	1000 bales	1000 bales
Factors	629	—	122	—	751
Country buyers	205	153	43	—	401
Country shippers	110	339	7	38	494
Salary for central merchants	11	212	10	—	233
Commission buyers for:					
Central merchants	71	99	4	—	174
Mill market shippers	17	23	17	—	57
Country shippers	30	3	5	—	38
Mill buyers	32	—	3	—	35
Total	1105	[1] 829	[1] 211	38	2183

[1] Includes approximately 126,000 bales entering Delta markets from factors and country buyers located outside the Delta.

merchants. Data are not available to determine the disposition of the cotton sent to the central markets but general information relative to the activities of central market merchants indicates that the cotton received by these handlers usually moved directly to domestic or export mill markets

Figure 1 shows, in diagrammatic form, the marketing channels for 1,231,000 bales of cotton that entered Mississippi Delta markets during the 1949-50 season. A high degree of specialization is evidenced by the fact that almost two-thirds of the volume going to central merchants went from salary and commission representatives of these merchants and over 90 per cent of the volume going direct to mill buyers went from country shippers.

Services and Charges

Services rendered in cotton marketing and charges made for these services may be separated into two segments: (1) services and charges prior to the time that producers relinquish title to the cotton and (2) services and charges that occur in the distribution of cotton from first buyers to ultimate consumers.[3] These two broad segments may be further divided into merchandising services and charges and physical services and charges.

Charges assessed for services performed before producers sell cotton are paid by producers. Table 4 reveals, that on the average, Delta producers pay $12.24 per bale for marketing services rendered before they give up title to their cotton. Of this total 94 per cent was for processing and physical handling. The table shows that the producer bears the expense of receiving at the compress and of storage and insurance for one month. Therefore all cotton was located in Delta or nearby warehouses at the time first buyers took ownership. First buyers purchased the cotton with a warehouse sample being accepted as representative of the quality of lint in the bale, and the warehouse receipt being accepted as evidence of physical existence of the bale.

Services and charges that occur in the distribution of cotton from first buyers to ultimate consumers vary widely between types of buyers. Lack of data makes it impossible at this time, to describe the services rendered and charges paid by handlers in central markets, consequently the discussion of services and charges will be confined entirely to merchandising activity in the local market.

Marketing services and charges occurring between the time cotton is purchased by first buyers and is sold to consuming establishments or to buyers in other markets are given in Table 5. These charges are based primarily upon estimates provided by members of the trade, because in most instances it was not possible to obtain accurate cost

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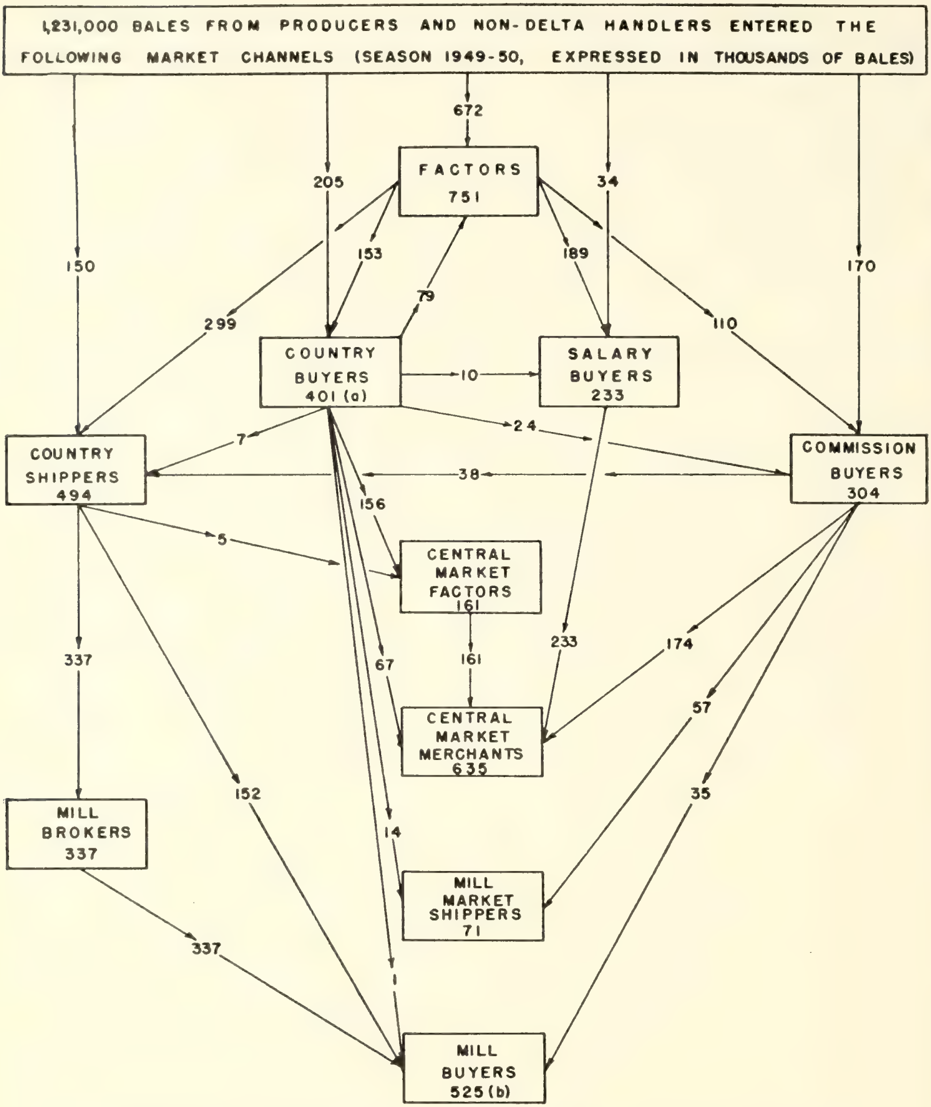
[3] First buyers include all buyers who take title to cotton either in their own name or in the name of firms which they represent.


1,231,000 BALES FROM PRODUCERS AND NON-DELTA HANDLERS ENTERED THE FOLLOWING MARKET CHANNELS (SEASON 1949-50, EXPRESSED IN THOUSANDS OF BALES)
672
205
34
150
170
FACTORS 751
153
189
79
299
110
COUNTRY BUYERS 401 (a)
10
SALARY BUYERS 233
24
7
38
COUNTRY SHIPPERS 494
COMMISSION BUYERS 304
156
5
CENTRAL MARKET FACTORS 161
337
67
161
233
174
57
CENTRAL MARKET MERCHANTS 635
MILL BROKERS 337
152
14
35
MILL MARKET SHIPPERS 71
337
1
MILL BUYERS 525 (b)

(a) Includes 43,000 bales bought by country buyers from other country buyers.
(b) Includes a small number of bales going to foreign mill buyers.

Figure 1. Marketing channels for cotton lint entering Mississippi Delta markets, 1949-50

Table 3.—Market outlets of indicated types of handlers Mississippi Delta, 1949-50.

Types of handlers	Market outlets									
	Central merchants direct	Mill buyers direct or through brokers	Mill market shippers direct or through brokers	Local representative of central merchants	Local merchants through local factors	Commission buyers for mill buyers	Commission buyers for mill market shippers	Country buyers	Country shippers	Total
	1000 bales	1000 bales	1000 bales	1000 bales	1000 bales	1000 bales	1000 bales	1000 bales	1000 bales	1000 bales
Factors	—	—	—	278	—	—	21	153	299	751
Country buyers	223	1	14	14	79	3	17	43	7	401
Country shippers	5	489	—	—	—	—	—	—	—	494
Salary for central merchants	233	—	—	—	—	—	—	—	—	233
Commission for:										
Central merchants	174	—	—	—	—	—	—	—	—	174
Mill market shippers	—	—	57	—	—	—	—	—	—	57
Country shippers	—	—	—	—	—	—	—	—	38	38
Mill buyers	—	35	—	—	—	—	—	—	—	35
Totals	635	[1] 525	71	292	79	3	38	196	344	2,183

[1] Includes a small number of bales going to foreign mill buyers.

Table 4.—Marketing services rendered and average charges assessed prior to sale of cotton by producers, Mississippi Delta, 1949-50.

Service rendered	Average charge per bale	
Physical services:		$11.45
Ginning and wrapping[1]	$10.57	
Receiving at compress and/or warehouse	.55	
Storage and insurance for one month	.33	
Merchandising services[2]		.79
Total		$12.24

[1] Estimated average charge per 500-pound gross weight bale. Source: Special tabulation of the Cotton Branch, Production and Marketing Administration.

[2] Charge computed by taking total payments by producers to factors and dividing by 1,105,000 bales.

data from the books of the firm. In general, failure to obtain accurate cost data was due to the lack of records rather than to an unwillingness to cooperate on the part of the buyers.

Commission and salaried representatives of country shippers, central merchants, mill market shippers, or mill buyers handled slightly more than 40 per cent of the cotton received in Delta markets in 1949-50. These buyers, who take title to the cotton in the name of the firms which they represent, reported no cost other than overhead which amounted to an average of 94 cents per bale (Table 5). Money paid to these buyers as salaries and commissions constitutes a significant part of the merchandising costs of the firms which they represent but this cost appears only on the books of the firms whom these buyers represent.

Country buyers reported wide variations in costs, ranging from 96 cents to $4.76 per bale. The average per bale cost reported by country buyers was $1.80 (Table 5). Of this total cost, $1.47 was for merchandising services and the remainder was for physical services. Country buyers who also acted as country shippers reported the highest cost per bale. In the case of these buyers no equitable distribution of such costs as overhead, banking, storage, and insurance could be made between the two types of operations. Since these costs are higher for buyers operating as shippers than for those operating as country buyers, it follows that a combination shipper-country buyer would incur higher costs than a buyer operating only as a country buyer.

Country shippers, disposing of practically all their purchases to buyers in mill markets, incurred heavier expenses for both merchandising and physical handling than did other types of buyers. Shippers secured a small amount of cotton through commission representatives, incurring a cash cost for this service, which other buyers did not report. They also held cotton for longer periods of time than other buyers, thus increasing the amount of storage, insurance, and interest costs which they paid. Exchange charges were higher due to the fact that drafts drawn on firms outside the area to whom shippers sold cotton bore a higher rate. Shippers also had to bear the expense

Table 5.—Marketing services rendered or paid for by first buyers and average cost per bale between the time cotton is purchased by first buyer and is sold to consuming establishments or to buyers in other markets, Mississippi Delta, 1949-50.

Types of services	Average cost per bale reported by: Salary and commission buyers	Country buyers	Country shippers
Merchandising services:			
Buying[1]	—	—	$0.08
Bank Expense[2]	—	$0.27	.42
Brokerage[3]	—	.46	.80
Overhead[4]	$0.94	.74	1.03
Total	$0.94	$1.47	$2.33
Physical handling:			
Compression	—	—	$1.01
Storage and insurance	—	.32	.51
Other charges paid compress[5]	—	.01	.09
Transportation	—	—	4.32
Total	—	[6]$0.33	[6]$5.93
Total average cost, all services	$0.94	$1.80	$8.26

[1] For cotton bought on commission by commission buyers.

[2] Comprised of exchange and interest on borrowed capital.

[3] For cotton sold through factors in local, central or mill markets.

[4] Includes all charges not specifically enumerated. Salaries, transportation, communications, classing, office expense, etc.

[5] Includes reconcentration costs, reweighting, resampling, etc.

[6] Weighted average cost for physical services performed on cotton moving to all destinations.

of preparing the cotton for shipment and of moving it to mill markets. Transportation costs alone accounted for over half of the total cash cost reported by shippers. This cost varied, of course, with the destination of the shipment. Thirty-four per cent of the total shipments reportedly went to New England at an average cost for transportation of $5.60 per bale; 37 per cent moved to Carolina-Virginia points at an average cost of $4.17; 17 per cent was sent to Georgia-Alabama points at an average cost of $3.62; and 12 per cent was moved to ports at an average cost of $2.80.

Since country buyers and commission or salary buyers transfer ownership of the cotton which they purchase to other buyers in central or local markets their reported costs indicate only a small part of the total marketing cost. Even the cash costs reported by shippers do not indicate the total marketing cost for they do not include such non-cash items as cost of risks arising from shifts in prices, cost of arbitration, losses in weight, cost of hedging, returns on owned capital, or returns to shippers for their services.

The total marketing cost can be determined, however, from the spread or difference between the prices paid producers and the prices paid by mills for the same qualities of cotton on the same dates. This study was not designed to collect detailed price data, but an approximation of this spread can be obtained from the officially quoted prices. The reports of the Production and Marketing Administration quote prices received by farmers in Greenwood, Mississippi and prices paid by mills in Group B Mill Points in the Carolinas. The margin or spread between these points indicates the total marketing charge for the most important volume of Delta marketings. During the 1949-50 season the average spread between the quoted prices at Greenwood and at Group B Mill Points averaged about one and three-fourths cents per pound for the four major classes of cotton sold in the Delta that season. This margin ranged from a high of two cents per pound for Middling 1-1/32 to about one and one-half cents a pound for Strict Low Middling 1-1/16 inches. Reports from buyers in local markets, other than Greenwood, indicated that the margin between these markets and mill points averaged about one- to two-tenths of a cent larger than the Greenwood-Mill Point average. However, there was no means of checking the accuracy of the buying basis reported or the quality to which the basis referred. The average total margin, estimated in the manner described above, ranged between $8.00 and $10.50, averaging about $9.50 per bale for the four major qualities of cotton sold. As can be seen from the foregoing discussion a large part of this $9.50 margin was paid to the compresses and railroads for the physical handling and movement of cotton to the mills.

The average cost reported by Delta shippers for physical services involved in moving cotton to Group B Mill Points totaled $5.77. This total is somewhat less than the weighted average total cash cost for cotton moving to all destinations reported in Table 5 due to the fact that cotton going to domestic mills is compressed only to standard density for which the standard cost is $1.00 per bale and the fact that transportation costs to Group B Points averaged only $4.17 or 15 cents below the weighted average cost of transporting cotton to all destinations. Merchandising costs would be about the same for cotton moving to all points so that the total average cost of moving cotton to Group B Mill Points amounted to $8.10 per bale. The difference of $1.40 between this figure and the average total spread of $9.50 indicated by the quoted prices is the return to the shipper out of which he must recover the interest on his own capital, the cost of disposing of bales rejected by mills, losses in weight, cost of arbitration and hedging, as well as the returns for his own services.

The estimated total cost including both cash and non-cash items for marketing cotton moving in the manner described above and including all charges occurring between the time the cotton arrives at the gin and the time it arrives at a Group B Mill Point siding, totals $21.74. Of this amount, charges for processing and physical movement amounted to $17.22 or about 80 per cent. The cash cost of merchandising amounted to only $3.12 or 14 per cent and non-cash items included in the returns to shippers amounted to $1.40 or 6 per cent.

Summary

The 1,231,000 bales of cotton entering markets in 1949-50 were handled an average of 1.8 times by local handlers. From the standpoint of volume, local factors were the most important, handling over one-half of the cotton that entered the market and supplying other types of handlers with three-fifths of their total receipts.

Of the 1,231,000 bales entering local markets, 49 per cent went directly to mill markets and 51 per cent went to central merchants.

Country shippers were the most direct link between local markets and mill markets and handled over 80 per cent of the cotton that went to mill markets directly from local markets. During the 1949-50 season the average spread between local market prices and Group B Mill Point prices was $9.50 per bale. According to reports from country shippers, cash cost averaged $8.10 per bale to deliver cotton to a Group B Mill Point siding, leaving $1.40 to cover interest on owned capital, risk from price changes, losses arising from rejection, losses of weight, arbitration costs, and returns to management.

The estimated marketing cost for this cotton including all charges or costs occurring between the time cotton arrives at the gin and the time it arrives at mill siding totals $21.74, of which charges for processing and physical handling accounted for 80 per cent.

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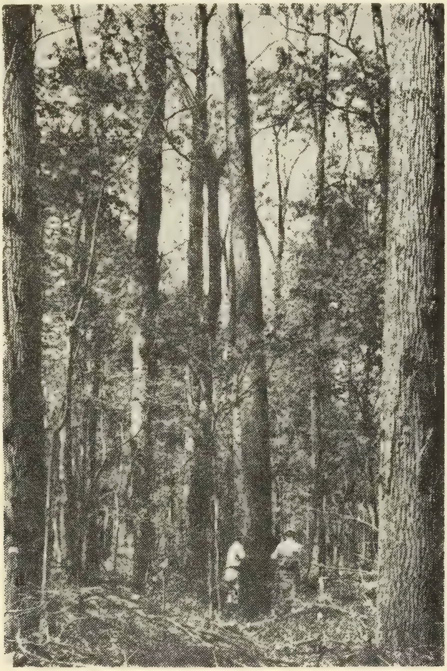

Planting And Growing Cottonwood On Bottomlands

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
CLAY LYLE, Director
STATE COLLEGE MISSISSIPPI

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Planting And Growing Cottonwood On Bottomlands

LOUIS C. MAISENHELDER[1]

Eastern cottonwood[2] is one of the fastest growing commercial trees in North America. The wood is almost always in demand for pulpwood, sawlogs, veneer stock, and a variety of other uses. Because of its value, its rapid growth, and natural preference for bottomland sites, cottonwood is an excellent tree to grow in plantations along the Mississippi River and the flood plains of other large southern rivers.

The present cottonwood plantations in the Yazoo-Mississippi Delta are mostly experimental, but a few of these experimental areas have been established by commercial operators. Interest in cottonwood planting is increasing as landowners recognize that much sub-marginal agricultural land, as well as odd corners and ditch banks, can be put on a paying basis by planting a fast-growing forest crop. In addition, a large acreage of heavily cut-over and burned-over forest area (usually covered with a dense growth of weeds, vines, and undesirable tree sprouts) lacks a seed source and can be reclaimed by planting cottonwood. Skid trails, logging roads, and the larger openings on cut-over land are good cottonwood sites if planted before vines and brush come in.

This bulletin summarizes the results of 10 years of research with cottonwood culture at Stoneville, Mississippi[3]. How to grow cottonwood profitably in plantations is now known, though future research and practical application will discover better methods.

Range And Uses Of Cottonwood

Cottonwood grows naturally on moist sites and thrives best in the lower Mississippi River valley, where large pure stands are found on the islands and the batture lands (the unprotected areas between the river and its levees). Young stands on such lands are commonly mixed with willow, but the faster-growing cottonwood gradually assumes a dominant position and large cottonwood is generally found in pure stands. Scattered individuals or small groups also occur in other hardwood forests throughout the bottomlands.

The wood is light-colored and generally straight-grained. Its freedom from staining materials and its lack of taste or odor make it ideal for pulpwood, excelsior, industrial lumber, and veneer. Because of its light weight and ability to take nails without splitting, the lumber is used in boxes and crates. Cottonwood yields a high percentage of clear wide boards for veneer core stock and for wagon box boards. The veneer goes mainly into soft drink and beer cases, berry baskets, egg crates, and the like. A considerable amount is used in furniture for partitions, backs, and drawer ends and bottoms. The pulpwood is made into both high grade book papers and cheaper fiber and wall boards.

Annual production of cottonwood lumber in the South in recent years has averaged about 86 million board feet. Most of this comes from the Delta regions of Mississippi, Arkansas, and Louisiana.

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[1] Delta Branch, Southern Forest Experiment Station, Forest Service, U. S. Department of Agriculture. In cooperation with Mississippi Agricultural Experiment Station, Stoneville, Mississippi.

[2] **Populus deltoides** Bartr.

[3] It supersedes Bulletin 391 of the Mississippi Agricultural Experiment Station, **Planting Cottonwood on Bottomlands,** by Henry Bull and H. H. Muntz, 1943.

In 1944 cottonwood ranked seventh nationally among veneer woods in the amount consumed.

Cottonwood usually matures in about 45 years. In natural stands on the better sites, it often grows 2/3 to 1 inch in diameter and 4 to 5 feet in height per year up to about 25 years of age. Planted trees do better than this. At Stoneville two-year-old trees increased 10 feet in height during their third growing season. The best first-year growth from a cutting was 12½ feet in height and 1.1 inches in d. b. h. (diameter at breast height, 4½ feet above ground). Trees up to 30 or 35 years of age grow only a little slower. Well stocked natural stands in the Mississippi Valley contain trees which average 20 inches d. b. h. and 120 feet tall at 35 years of age. Growth usually begins to decline sharply at about this age, however, so that at least part of the trees should be harvested.

In the fall of 1947 a commercial logging operation removed about 60 percent of the volume from a 55-year-old stand whose diameter growth had declined noticeably ten years previously. Cutting was on a tree selection basis, and took mostly trees of poor to medium vigor. The release given the remaining trees of good vigor stimulated their diameter growth, even though many of them were 30 inches d. b. h. or over (figure 1). In the ten years preceding the cut these trees—which were on a good site in the batture—had grown 3.2 inches in diameter. Two years after the cut they were growing at the rate of 4.8 inches in 10 years—an increase of 50 percent.

Growth rate varies with site, the more moist locations ordinarily producing the better growth. In one plantation, 6-year-old trees on a ridge averaged 2.6 inches d. b. h. and 22 feet in height. In the

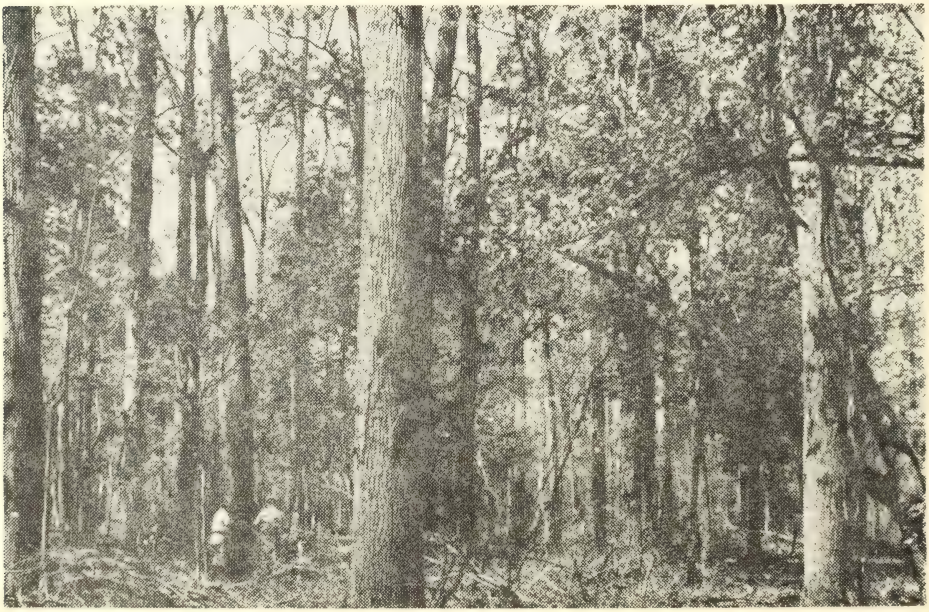

Figure 1. A 55-year-old unmanaged cottonwood stand on batture land. Managed plantations on comparable sites can be expected to do as well or better. A commercial timber sale has just removed about one-third of the total saw timber volume of 36,000 board feet per acre (Doyle rule). The remaining trees, which will be removed in a final cut some ten years hence, range from 20 to 32 inches in diameter and are still increasing rapidly in volume and value.

same plantation but on a gentle slope from ridge to swamp—a more moist location than the ridge—trees averaged 4.1 inches d. b. h. and 31 feet high. Similar variations can be expected in most areas.

In well-stocked natural stands, cottonwood prunes itself very well, and produces a long, straight trunk that is generally clear of limbs for at least 50 feet when mature. Such stands on good sites have been estimated to yield about 24 cords of pulpwood at 10 years and 50 cords at 15 years. The volume in board feet per acre, Doyle rule, in similar stands has been estimated at 5,700 at 20 years; 10,700 at 25 years; 19,200 at 30 years; and 27,500 at 35 years. Most natural stands, especially over large areas, are not fully stocked and therefore do not attain these yields, but in Iowa plantations 30 to 40 years old with high survival and uniform spacing seem to be producing at comparable rates.

Natural Reproduction

Cottonwood reproduces naturally from seed only under very exacting conditions. Bare soil that remains saturated with water (but not flooded) for long periods during seedfall is essential. Natural reproduction occurs principally on sand bars and other accretion lands along the larger rivers. Here optimum growth conditions exist, and extensive pure stands or mixtures with willow result. Less extensive stands occur on protected sites along water courses, drainage ditches, and borrow pits. Old fields occasionally seed in to cottonwood.

The site must remain moist and free from competing vegetation during the first growing season if good growth is to be obtained. Cottonwood will stand silting if only a short length of the stem is covered. It is, however, very intolerant of shade and will not develop even under very sparse stands of trees. Adequate natural reproduction is almost never found on land from which mature cottonwood has been cut; seedlings that start are soon killed by the shade from residual trees and from the heavy ground cover which develops after cutting. Where cottonwood is found in mixed hardwood stands it has originated in openings.

Planting and Cultivating

To begin with, every prospective cottonwood planter must realize that unless he is prepared to carry out all the operations that are required at the proper time and in the prescribed manner his venture has little chance of success. During the first year, care of the tree crop will at times interfere with work on other field crops, and it must therefore get proper priority in the work program for the farm.

Choice of Planting Site

The first step is to determine where planting is needed and where it will succeed. Abandoned farm lands generally should be planted, as natural restocking is usually either unlikely or will take too long.

One land condition which may or may not require planting is the "brush patch," in which annual weeds, briars, vines, and shrubs form a dense ground cover. Where this is the only vegetation, planting is needed. Often, however, close examination discloses tree sprouts and seedlings, usually of other species than cottonwood. If not too heavy, the briars and weeds act as a nurse crop for the trees and are usually more beneficial than harmful. If as many as 700 to 1,000 good seedlings per acre of desirable species are found, planting is unnecessary and a suitable stand will usually develop without aid.

In the Mississippi Delta cottonwood does best on moist, well drained fine sandy loam or silts in the batture, but it also thrives on the heavier clays of gentle slopes bordering swamps or sloughs. The heavy clay "buckshot" soils which dry out and crack open in the late summer are less favorable, but planting can succeed even here if the best practices are carefully followed and if the first summer is not unusually dry.

Wood sites unsuitable for cottonwood are ridges of coarse sand (former sand bars), which are common in batture. These can usually be recognized by their complete lack of any tree growth; in fact, when the water table falls in summer they commonly become so dry that they support only a sparse stand of grass. A few borings with a soil auger will check on this condition. Swampy areas where floods or backwaters are likely to submerge the trees completely for several days during the growing season are also entirely unsuitable.

Heavy clay soil which has lost all its organic matter by exhaustive cropping and has become stiff and waxy at the surface will not grow cottonwood. A stunted, sparse growth of weeds on an area which has been abandoned for several seasons is usually an indication of these conditions. Such areas might be made suitable for cottonwood by plowing under leguminous cover crops for several years, thus building up the organic content of the soil; but this practice has not been tested. Most other bottomland sites in the Mississippi Delta seem satisfactory for cottonwood unless they are extremely dry in the late summer and fall, or are under water during the growing season.

In general, cottonwood does not survive or grow as well in the small stream bottoms of hardwood or pine areas as it does in the first bottoms of larger streams. It is often difficult to evaluate a site from its appearance, so it is best to try small-scale planting a year in advance of undertaking a big planting job on a new area. Often the non-Delta sites are poor for cottonwood because soils are shallow, dry, or impervious and change from standing water to very dry conditions in a short time.

Cottonwood can serve as living dams in moist gulley bottoms and along the margins of all but the smaller streams in erosion and flood control work, though its growth will be slower than on better sites. The fact that it is one of the few trees not too adversely affected by silting-in around the stem adds to its desirability for this use.

Site Preparation

Before planting, all sites should be disked to remove existing plant cover. Planting cottonwood without site preparation—and subsequent cultivation—is almost always doomed. Weeds and vines cause heavy mortality and greatly reduce vigor and growth. Even if survival is occasionally good, vigor is likely to be poor.

Except where the trees are to be set in furrows, the ground should be left flat to facilitate later machine cultivation. To avoid forming large clods which are easily rolled onto the small trees during cultivation, the planting site should be worked in the fall before it has been soaked by winter rains.

Where strips of undisked land are left between the rows, the disked strips should be made wide enough to accomodate the type of cultivators that will be used later. They should always be at least 5 feet wide (2½ feet on either side of the trees) to prevent excessive competition from vines and weeds on the sides of the strip.

Recommended practices. On abandoned farm lands or open areas in the woods not densely covered with vines or shrubs, a disk harrow or a heavy farm disk of the bush and bog type has been used successfully. On such sites it is best to work the entire area, for then all weeds are eliminated at the start and later cultivation can be done by any of several methods. Twice over usually destroys the ground cover, and cross-disking is very effective. Planting in furrows made with a middle-buster plow stimulates growth on the drier sites, but increases the difficulty of machine cultivation. Furrows, therefore, are practical only where all cultivation will be done by hand. Cross-disking an acre of land with a wheel tractor and a two-row disk harrow requires 1.1 hours and costs about $2.00[4].

On large open woods areas with dense vines and weeds, planting strips are recommended to save expense. The strips should be at least 5 feet wide and spaced 10 feet apart center to center. A Mathis four-disk fire-line plow produces a strip of the proper width by cutting the brush and vines about 6 inches below ground level and pushing the debris out to the sides. The result is a flat, clean trench in which to plant. This plow has performed better than any machine tested. It is expensive but can perhaps be rented from county or State forest fire protection agencies. There are preliminary indications that a self-propelled rotary tiller may be cheaper and more effective than the Mathis plow.

For best results in plowing, cull logs, windfalls, and other debris should first be hauled onto the strips to be left uncleared. Table 1 summarizes costs of clearing and plowing strips with the Mathis plow. The figures are from a small trial under the worst conditions under which planting would be considered. There were many logs and windfalls, and the workmen were unfamiliar with the work. Easier working conditions and more experienced labor will lower the costs materially.

Logging roads, skid trails, and loading spots. On areas logged in late summer or during the fall and winter just prior to planting, site preparation usually is not needed, especially as logging roots up the ground somewhat. Earlier logging, however, will be followed by a crop of weeds which must be removed; a bush and bog disk will do the job.

In forest openings created by the removal of individual trees or groups of

Table 1. Costs per acre of site preparation with Mathis plow.

Item	Time required	Cost per hour	Total expense
	Hours	Dollars	Dollars
Removing logs and down trees			
Supervision (working foreman)	0.9	1.00	0.90
Labor (tractor driver)	.9	.75	.68
Equipment rental	.9	2.50	2.25
			3.83
Plowing			
Supervision (working foreman)	1.55	1.00	1.55
Labor (tractor driver)	1.55	.75	1.16
Equipment rental	1.55	3.50	5.43
			8.14
Total for clearing and plowing			11.97

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[4] Unless otherwise indicated, labor costs given in this publication are figured at the following rates:

Unskilled labor	40c per hour
Tractor drivers	50c per hour
Supervisor (working foreman)	$1.00 per hour

Cost figures throughout the bulletin are from experience at the Delta Branch or, for the use of farm machinery, are adapted from Grady B. Crowe, **Tractor Machinery: Costs and Performance.** Mississippi Agricultural Experiment Station Circular 157, 7 pp. 1951.

trees it is probably best to rely on natural reproduction.

Less satisfactory practices. Several additional site preparation practices have been tested. They are not recommended for general use but may be adaptable to special situations.

Two fire-line plows failed to clear strips wide enough to permit machine cultivation. The Ranger's Pal plow was too light to make a satisfactory furrow in heavy buckvine. A heavier hydraulically controlled plow that made a furrow about three feet wide seemed satisfactory at the time of plowing, but by the end of the first growing season vine sprouts from along the edges of the furrow had closed in over most of the planted cottonwood and were seriously restricting growth.

Scarifying planting strips with a bulldozer proved impractical because the survival and growth of trees planted on the strips were poor while the cost of the work was high. Attempts to do good work with the bulldozer resulted in working practically the entire area and leaving the debris piled in windrows. As used, this machine cut only about 3 inches deep, not enough to prevent vigorous sprouting from the roots of the vines. To cut as deep as the Mathis plow would involve moving double the amount of earth and debris and thereby increasing the cost of the job—and the difficulty of getting around the area later.

Spacing

How far apart should cottonwoods be planted? Spacing ranging from 6 by 9 to 9 by 9 feet (providing from 55 to 80 square feet of growing space per tree) are most satisfactory. Such spacings are suited to the production of both pulpwood and sawlogs. Regardless of the product cut, frequent thinnings will be needed in order to obtain maximum yields and profit, but the trees will probably have room enough to reach pulpwood size before the first thinning is necessary. These spacings are also convenient for machine cultivation.

At spacings of 6 by 6 and 4 by 10 feet, survival and height and diameter growth are less than in wider spacings. Spacing 10 by 10 feet or wider may cause understocked stands on swamp sites, and considerable mortality usually occurs through windfall and ice damage.

The cultivation method to be used will also influence the spacing. Following are recommended spacings for the methods described later.

1. Cross disking between rows: Set trees 9 feet apart in rows 9 feet apart. This distance may be varied slightly according to the width of the disk, so that the entire space between rows can be worked on one trip through. This spacing and cultivation method is best adapted to fairly good sites on abandoned farm land where at least three-fourths of the planted trees can be expected to develop vigorously.

2. Disking one way between two rows: Make rows 9 feet apart (distance may be adjusted to the width of the disk as explained above) and space the trees 6 to 8 feet apart in the row. This spacing gives more trees per acre than method 1 and is best for the drier and less productive abandoned farm land where approximately two-thirds of the planted trees can be expected to grow vigorously.

3. Cultivating 5-foot-wide planting strips with a cultivator that works both sides of the tree row: Make rows 10 feet apart and space the trees 6 feet apart in the row. Use this technique where vines and brush are so dense that it would be exorbitant to clear and cultivate the entire space between rows. Trees may sometimes be spaced as much as 8 feet apart in the row, but 6 feet will generally be better because the difficulty of adequate cultivation on such sites will increase mortality.

Time of Planting

Cottonwood may be planted at any

time during the dormant season. In the Yazoo-Mississippi Delta this season extends from the first severe frost in the fall until the buds begin to open in the spring. Planting material should always be checked for dormancy before use. The succulent green tissue of rapid growth may persist for a short time after the first fall frost, but the buds and current season's growth must have stopped growing and be hardened before cuttings are made.

February is the best month for planting. The ground is usually wetter then than in the two preceding months, especially on the higher sites; and drying winds, high water, rabbits, and other injurious agencies will have less time to damage the stock before it sends out roots and attains some recuperative capacity. On a big planting job, work may start in December and continue into April, beyond the start of the growing season. Delayed planting may also be desirable on very low sites where backwater or spring floods interfere during the normal planting season. Such late planting requires keeping stock dormant by cold storage.

Floods which entirely submerge the trees while they are dormant do not seriously affect survival if the water subsides before leafing out begins. One Delta plantation, planted the first week in March, was immediately covered with eight feet of water; the cuttings remained under water until the first week in April, yet 75 percent of them leafed out. Once the trees leaf out, however, 48 hours of complete submergence will kill nearly all of them. Ten or fifteen percent may sprout a second time but their vigor will be poor and growth will be slow. Partial submergence with some or all of the leaves remaining above water, even for two to four months, is not harmful to first year cuttings or older trees if the water does not become unaerated or hot enough to scald the cambium tissue of the stem.

Delayed planting is advantageous only on the lower, wetter sites and cannot be used on the drier ridges. The disadvantage of late planting is that the short growing season may not allow cuttings to make enough height growth to avoid submergence the second growing season.

Rainfall often controls plantation success. Tests on drier planting sites bordering sloughs have shown that stored stock may be planted as late as the first week in May with fair success as long as there is sufficient rainfall throughout the growing season. To guard against poor results in the event of unfavorable weather following planting, it is better to regard April 30 as the latest planting date on drier sites.

Planting in swamps immediately after flood waters recede has not been tried but, judging from results obtained on less moist sites, late planting may succeed under such conditions. With dormant stock, dates as late as early June may be feasible, as natural reproduction often starts that late and survives in similar locations. However, there is danger of second-year flood damage if the first growing season is too short to allow the trees to grow above flood levels. Probably planting should not be attempted where floods deep enough to submerge the trees completely are expected annually.

Planting Stock

There are two practical classes of planting stock: (1) Cuttings taken from one- to three-year-old seedlings; such cuttings may be entirely stem material or may include a part of the seedling root. (2) Stem cuttings from one- or two-year-old sprouts originating within six inches of the root collar on stumps from one to five years old. Low material from older stumps has not yet been tested but would probably be satisfactory.

Stem cuttings survive and grow as well as those having some root, and are usually easier and cheaper to collect. One- or two-year-old seedling stock on river sand bars usually uproots easily and yields a larger number of cuttings per seedling if stem cuttings as well as stem-root cuttings are used.

Cuttings from vigorous one-year-old wood in the crowns of trees 4 years and older are not recommended; they frequently fail to take root.

Where only a few thousand cuttings are desired, they can usually be obtained cheaply along drainage ditch banks or in highway borrow pits on the safe side of the levee. Larger quantities rarely occur except on bars along the Mississippi and other large rivers, and high water or impassable roads often make such stands difficult of access during January and February, when the collecting must be done. The establishment of cutting nurseries, therefore, appears to be the best solution where a large planting program is planned. Instructions for setting up such nurseries are given later in this publication.

Planting stock can be harvested either by pulling seedlings up by the roots or by cutting them off about six inches above the ground. Cutting is the fastest and cheapest and has the further advantage that the rootstock left in the ground will send up sprouts which can be harvested year after year. Thus, well-located natural stands can serve as nurseries. Severing the sprouts about 6 inches above the ground instead of at ground level encourages multiple sprouting from the stump and thus increases the yield of cuttings.

After harvesting, the cottonwood switches must be cut into sections of the proper length for planting. Cuttings 20 inches long are suitable for most areas. On sites subject to shallow flooding during the growing season, 25-inch lengths help prevent complete submergence. Twenty-five inch cuttings are also recommended for deep planting on dry sites.

All lateral branches should be trimmed off flush with the main stem. Laterals that are large enough may be made into cuttings. Cuttings should range from 3/8 to 3/4 of an inch in diameter at the small end. Sizes smaller than this dry out excessively after planting and contain too little stored food to give the tree a good start. Sizes larger than 3/4 inch are hard to handle and plant, though once in the ground their survival and growth are good. Crooked sections of stem should be discarded, since they cannot be pushed into the ground easily and will usually be planted improperly. The taproot of cuttings containing a portion of the seedling root should be cut back to 15 inches or less, until it is stiff enough to insert in the planting hole, and the larger side roots should be pruned enough to permit this insertion.

Cuttings can be mass-produced by laying several switches at a time on a block and chopping them all off at once at right angles to the axis of the stem with a sharp tool. Chopping must not smash or split the ends of the cuttings, since this will cause failure to sprout when the cuttings are planted. For ease in handling and counting, cuttings should be tied in bundles of 100 with all the butt ends pointing in the same direction.

Costs of making cuttings. Harvesting sprouts with a machete in a nursery and bunching them for transportation takes about three-fourths of a man-hour per thousand 20-inch cuttings.

Preparing the cuttings is one of the more costly items in the planting program. A power saw or other instrument to cut large numbers of switches at one time is desirable. Trimming the laterals and cutting shoots to length has taken 4 man-hours of work per thousand cuttings. Counting and bundling has taken 1 1/4 hours more. With labor at 40 cents an hour, this is a total of $2.10. Practical experience on a large scale will surely reduce these costs.

Storing cuttings. For temporary storage for a few days during the planting season, the stock may be kept safely by placing the roots of seedlings and the butt ends of cuttings in water (ditches or stump holes), or by heeling-in in moist soil. Less care is required for cuttings than for rooted seedlings, but they should not be exposed to the sun or wind. Covering them with wet burlap sacks is good practice.

When planting will be done after the start of the normal growing season, the buds must be prevented from opening. A cold storage locker where the temperature can be maintained between 28° and 32°F. will be necessary. Cold air must be kept circulating around the cuttings to prevent them from sprouting in the locker. Bundles should be set butt end down in a 2- to 3- inch layer of moist sand on wooden duckboards placed over the permanent floor. Several layers of bundles, one on top of the other, can be used to save space. Each layer should be covered with wet burlap sacking over which is spread a layer of wet sand to serve as a moist base for the next higher tier of bundles. When it is necessary to have more than 36 bundles per layer, a perforated wooden flue or chimney, 6 inches square, should run through the center of the whole pile to ensure air circulation. The sand, burlap, and cuttings should be thoroughly sprinkled with water twice a week.

Cuttings stored in this manner for 8 months have produced as high as 75 percent survival. Results are best when cuttings are planted the same day they are removed from storage.

Method of Planting

The spacing to be used will have been selected well before planting time, but the location of the rows should be clearly marked just prior to planting. On disked areas this can be easily done by ordinary farm row-marking equipment. Reasonably straight rows are important where cultivation is to be by machine. It is best to mark the rows in both directions when cross cultivation is planned, but otherwise the spacing in the row can be determined by pacing the distance as the planting is done. If planting strips are used, the trees are merely set in the middle of the strip. On rough woods areas, uneven spacing between rows and between trees within the row will often be necessary to avoid stumps, stump holes, or down trees and other debris.

A planting rod is easy and cheap to make, and quick to use. It should be of rod iron, bent at 15 inches from one end to give a step for pushing it into hard ground. The upper end should form a convenient handle, preferably L-shaped, and the lower end should be pointed (fig. 2). A 5/8-inch rod is preferable for most seedlings and sprout cuttings, but a 3/8-inch rod is best for the smaller cuttings made from the tops of seedlings.

There must be contact between the planted tree and the soil. Cuttings must be pushed all the way down to the bottom of the hole. Shallow planting results in poor survival and reduced height growth. The top of the hole should be closed by a kick of the heel. If the soil is very wet and soft, the cuttings may be pushed in 15 inches without using a rod. In the drier soils, it is undesirable to plant without a rod or to use a rod of smaller diameter than the cuttings. The bark may be stripped off or the cutting broken as it is forced into the ground.

Mattocks or wedge-shaped pine planting bars are slower than a rod, especially in wet clay soils, and do not improve survival or growth.

Costs. The cost of planting varies with the efficiency of the crew and the size of the job. Fairly well trained men on a small job took 5 1/2 man-hours (at 40 cents per hour) to plant an acre of 20-inch cuttings at 6- by 10-foot spacing (726 trees). Supervision was furnished by a working foreman who planted most of the time.

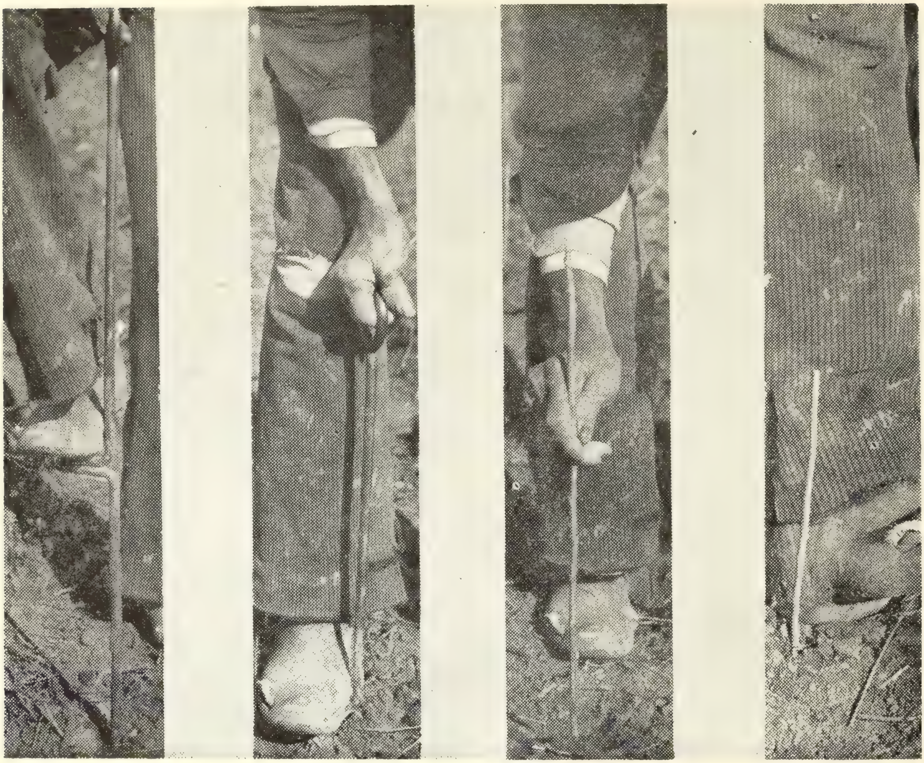

Figure 2. Four steps in planting a cottonwood cutting: (A) Starting planting rod into the ground. (B) Pushing rod down to the step (15 inches). (C) Putting a 20-inch cutting in the hole. (D) Closing the hole by a kick of the heel. This cutting was purposely planted shallow to illustrate the procedure. Only 5 inches should be left above the ground in actual planting practice.

Cultivation

Cultivation to release the planted trees from competing vegetation is absolutely essential during the first year. It not only controls weeds but also conserves soil moisture and incorporates organic matter into the soil.

From the very earliest attempts to grow cottonwood it has been apparent that this tree is most intolerant of competition from weeds and vines. Heavy mats of trumpet vine and buckvine are probably the worst ground cover. Heavy grass sods also reduce survival greatly. The grass roots compete for moisture and nutrients, and cottonwood also seems sensitive to some chemical or biotic inhibitor associated with grass.

Number of cultivations. Cultivations must be frequent enough to prevent other plants from overtopping the cottonwoods. At no time during the first growing season should the average height of weeds be allowed to exceed one-half the height of the trees. One properly timed, thorough cultivation may suffice in seasons especially unfavorable to weed growth. It is much safer, however, to plan on two cultivations—an early one to set back the spring weeds and a later one to knock down late starting summer weeds like ragweeds, coffee weed, and goldenrod. In an unusually wet year a third cultivation may be required.

Usually the first machine cultivation is made in late April or early May and the second in early July. When a third release is necessary it may come either between April and July or, if late summer rains have been heavy, in the fall. These are approximate dates only; the best rule to guide time and number of cultivations is the basic one of never allowing weeds to become more than half as tall as the trees.

Cultivation is rarely necessary in the second growing season, although weeds should never be allowed to overtop the trees.

Recommended cultivation methods. The following cultivation methods are recommended: (1) Cross disking between the rows, (2) disking between the rows in one direction only, (3) straddling the row with a cultivator that works both sides at the same time, and (4) hand hoeing as a supplement to machine work.

Cross disking is the cheapest and best type of machine cultivation on the better sites of abandoned farm land. If trees are correctly spaced, a minimum of hand work is necessary, but where reasonably cheap labor is available it is often advantageous to hoe any weeds missed by the second cultivation.

Disking between rows in one direction only is a good practice on poorer abandoned agricultural land where considerable mortality is expected and close spacing within rows is necessary to obtain satisfactory stands. One hand hoeing is needed to remove the weeds remaining between the trees. This should be done before the trees are overtopped, probably immediately after the second machine cultivation.

Cultivating with a machine that straddles the row of trees appears to be the most practical way to work narrow planting strips in rough woods so covered with vines and brush that cultivating between the rows is impossible. No straddle-cultivator has been sufficiently tested to determine whether it is rugged enough to overcome roots and stumps without numerous breakdowns, but the only alternative is hand hoeing.

Hand hoeing with ordinary cotton-chopping hoes to clear an area five feet in diameter around each tree has in all tests produced the best survival and the greatest height growth in the first season. By itself, hand-hoeing is very costly, but it is a very useful supplement to machine work where labor is cheap and plentiful.

On recently abandoned farm lands, corn can be planted between the tree rows the first year, and probably the second year also. The rows of cuttings should be spaced about 9 feet apart, with two rows of corn between the rows of trees. Trees should be 6 to 8 feet apart in the row, to make a 6- by 9-foot or 8- by 9-foot spacing. The corn will be cultivated incidentally as the trees are worked, and will thus provide an immediate cash return with little extra outlay of money or labor.

Costs. The cost of cultivation will vary with the locality and size and type of operation, but the figures in table 2 are typical under many conditions.

Unsatisfactory weed control methods. Several other methods of weed control have been tested and found unsatisfactory.

Flame cultivation with the machine used in cotton culture caused 20 percent mortality because the heat destroyed the cambium layer around the cottonwood cuttings. Even if less lethal flame techniques should be worked out, special machines of more rugged construction than the cotton cultivators would be needed on rough planting sites.

Soil sterilization by white arsenic scattered on top of the ground controlled annual weeds fairly well during the first year, but the deeper rooted vines and brush soon overtopped the cuttings. The possibility of poisoning humans, livestock and wildlife is a further drawback to this method.

When strips were prepared with the Mathis plow but not cultivated after

Table 2. Cultivation costs per acre per treatment (6- by 10-foot spacing)*

Method	Time	Cost
	Man-hours	Dollars
Hand hoeing alone		
Unskilled labor	33	9.90
Hand hoeing to supplement machine work		
Unskilled labor	25	** 7.50
Cross disking between rows		
Tractor driver	1.14	.58
Tractor and disk rental	1.14	1.48
Total cost		2.06
Disking between rows one way only		
Tractor driver	.57	.29
Tractor and disk rental	.57	.74
Total cost		1.03
Cultivating astraddle the planting strip		
Tractor driver	*** .75	*** .32
Tractor and cultivator rental	*** .75	*** .60
Total cost		.92

*All methods except cross-disking, where spacing is 9 by 9 feet.

**This figure is for plantations disked one way only. It should be lower in cross-disked areas where there are fewer weeds.

***Time and equipment rental estimated from similar work, no actual records available.

planting, the vines were controlled but annual weeds soon overtopped the seedlings.

Use of 5-foot-square patches of building paper as a mulch to keep down weeds was prohibitively expensive, and the vegetation around the paper patches and some which came up through unavoidable breaks in the paper seriously retarded tree growth.

Chemical weed control by the pre-planting method of treatment was tested with several chemicals in common agricultural use. Most of these controlled weeds for six or eight weeks following application. They failed, however, to control the late summer weeds and at least one mechanical cultivation was necessary. Tree growth on treated areas was retarded. Post-planting treatments of late summer weeds would affect the cottonwood still more seriously. The cost of the chemicals is high[5] and practical application would require a sturdier machine than is now available.

Fertilizing cottonwood cuttings with ammonium nitrate at planting time stimulates their growth, but unless the trees are also cultivated they still cannot keep ahead of the weeds. Ammonium nitrate gives erratic results under varying weather conditions. During wet seasons almost any combination of fertilization and release produces satisfactory results, but during dry seasons the weeds are stimulated more than the trees, thus increasing the need for cultivation. When used at planting time the nitrate should be applied at the rate of 2 ounces per tree. To prevent damaging the roots, it should be

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[5] The following costs are based on 1948 prices. No reliable application costs are available since all work was done by hand on small experimental plots.

Chemical	Application rate	Cost
Dow Selective No. 27	2.5 gals. per acre	$ 6.88
Sodium salt of 2, 4D	5.2 lbs. per acre	5.41
Allyl alcohol	50.5 gals. per acre	143.93
Calcium cyanamide	40.0 lbs. per M sq. ft	47.92

distributed in a ring on the surface of the ground around each cutting, but at least 6 inches away from the cutting itself.

With good moisture conditions, hoeing combined with the use of fertilizer has produced survival of 75 to 95 percent and individual trees 10 to 12 feet high in a single season. Under adverse conditions mortality has been very heavy.

Since fertilization costs about $6 per acre (726 trees) and depends for success on the amount and time of rainfall, it cannot be recommended except perhaps as a gamble with late plantings in swamps to help offset the effects of a shortened growing season. The ill effects of fertilizing on such wet sites should be at a minimum.

Survival

Survival at the beginning of the second growing season in the field varies from 65 to 90 percent, depending on site, cultivation, and rainfall during the growing season. The moister swamp and slough sites generally have the better survival and growth, although ridge sites which do not dry excessively in the summer may be almost as good.

A satisfactory first-year plantation should contain at least 400 well-spaced vigorous trees tall enough to stay above ordinary flood-water and to outgrow competing vegetation in the second year without further cultivation. With 6- by 10-foot spacing, about 56 percent survival is required to obtain 400 trees. For most Delta sites the minimum satisfactory first-year height is 36 inches. Experience may suggest shorter or taller minimums for particular localities. If the total survival is over 80 percent only 40 to 50 percent of the trees need be over 36 inches tall, since enough of the shorter trees to make up the difference can usually out-grow the competition in the second year. Where competing vegetation is considerably less than 36 inches tall, trees averaging shorter than 36 inches at the end of the first year may survive satisfactorily.

Replanting small blank spaces before the start of the second growing season is inadvisable, since replants will be suppressed by initial survivors in a year or so. When more than 1/8 acre has failed, it can be replanted if the cause of the failure is unlikely to recur.

On good sites few trees die after the first year. Second-year mortality on Delta sites averages 5 or 6 percent. On sites outside the Delta, it has ranged from 8 to 54 percent.

Growing Nursery Stock

A nursery for growing cottonwood planting stock will pay for itself whenever a few thousand cuttings are needed annually for several years. It should be established on moist, fertile sandy loam soil in an easily accessible location.

Cutting Nurseries

The nursery may be started either from cuttings or from seed, but the former method is much easier and more economical. By this method cuttings of the same specifications as for field planting stock are planted in the manner already described.

Cuttings for a nursery should be taken from none but the most vigorous 1-year-old seedlings, since the cuttings to be grown will have the characteristics of the parent tree. The most vigorous seedlings are usually the tallest, and their stems are dark green rather than dull brown.

Cuttings should be set out in the nursery at a spacing of 1 foot by 3 feet, or about 14,500 per acre (fig. 3). The 3 feet between rows allows for economical cultivation with a four-row cotton cultivator. Two or three cultivations will be necessary the first year. Two are usually adequate the second season, and none in subsequent years. After the second year, annual sprouts from uncultivated rootstocks will outgrow everything except

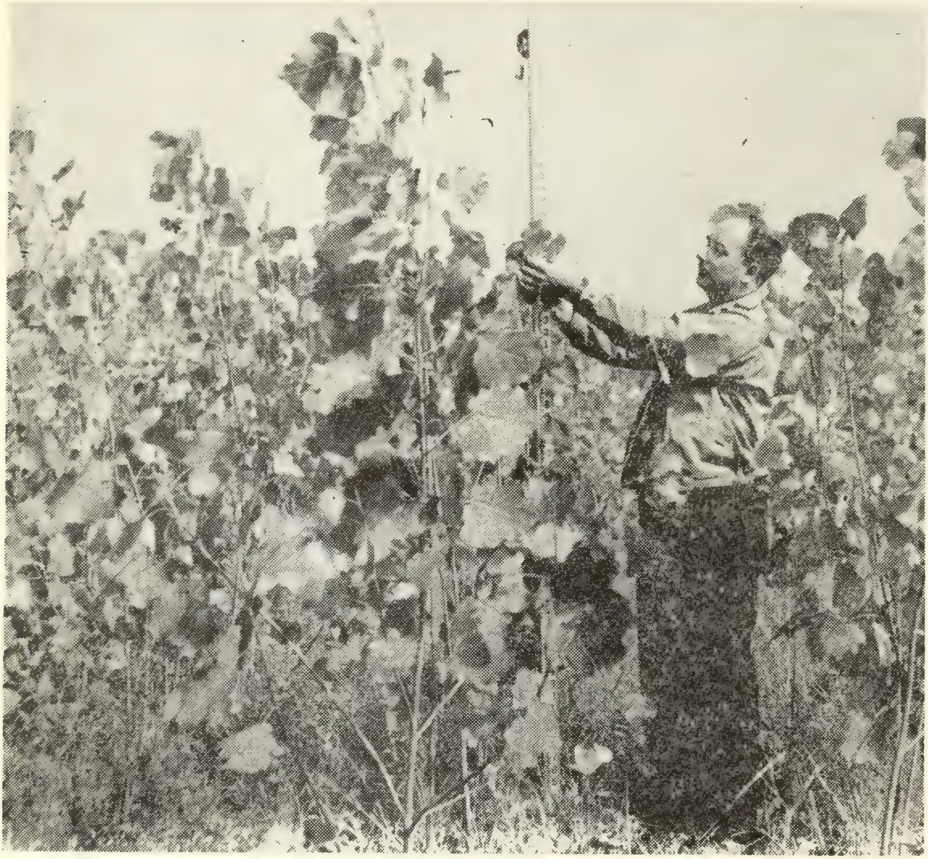

Figure 3. One-year-old cottonwood sprouts on two-year-old rootstocks in a nursery started from cuttings. Spacing 40 inches by 12 inches.

possibly Johnson grass, but sod should never be permitted to form. The nursery must also be protected from fire and grazing throughout its lifetime.

With average site fertility and weather, annual production will be approximately 25,000 twenty-inch cuttings. At least six annual harvests can be made from the same rootstocks before the sprouts become too large in diameter for economical use. After the first year, branches from some of the main stems of sprouts will yield 3/8-inch cuttings. Production from an acre of nursery will plant 34 acres annually at 6- by 10-foot spacing.

The cost of establishing and caring for a one-acre nursery for six years (1945 through 1950) has been about $70 (table 3). Thus the nursery charges (exclusive of harvesting, trimming, bundling, storage, and transportation) against the approximately 150,000 cuttings yielded has been only 47 cents per thousand. If rootstocks can be used longer, this average charge will decline.

Nursery Stock From Seed

Raising cottonwood seedlings from seed is an exacting operation not recommended for general use. It will, however, be necessary to employ this method in any tree breeding work directed toward the development of elite strains. The requirements for propagation in the nursery also indicate the conditions which must exist where successful natural regeneration is sought.

The following discussion is taken from Mississippi Agricultural Experiment Station Bulletin 391, **Planting Cottonwood on Bottomlands,** by Henry Bull and H. H. Muntz. Some changes have been made in order to include the latest findings.

Seed Collection. Cottonwood seed is usually mature early in May in the central portion of the Yazoo-Mississippi Delta. Seed fall generally occurs from about the first of May until July or August, with dissemination at its peak in late May. Seed may be safely collected after the first of May, and frequently collection is possible from a few late-maturing trees in June. A good rule is to collect when the first pods begin to open; if collection is delayed too long, lower yields of seed per tree will be obtained.

The best seed-bearers are large, open-grown trees. Usually little seed can be collected from trees less than 10 inches in diameter at breast height or less than 10 years old. Seed is borne only by female trees, and abundant crops are produced every year. Female trees bear yellow flowers, and male trees bear red flowers.

The green pods or capsules are most easily gathered from felled trees. Logging operations are convenient places to collect seed. A large tree may yield over a bushel of seed pods, from which several pounds of seed can be extracted. A pound of seed, clean enough for sowing, contains about one-half million seeds.

Table 3. Costs of establishing a one-acre cottonwood nursery.

Item	Cost
	Dollars
Securing original cuttings	31.20
Preparing site (3 row middle-buster and harrow)	2.00
Planting (13 M cuttings—72 man hours @ 30c per hour)	21.60
Cultivating	15.00
Total	69.80

If stored in bulk following collection, the pods will heat; they should therefore be spread out in thin layers to precure or dry at ordinary room temperatures for 2 to 3 days before the seed is extracted. Most of the pods will still be closed but sufficiently dry to be easily opened. The pods may be air-dried for a week or more with little or no loss of seed viability, and even longer storage periods are possible, in moist, cold storage at about 40° F.

Crushing or rubbing the pods against a coarse screen releases the seed, and to some extent loosens it from the cottony matrix which surrounds it. Portions of the seed pods will fall through the screen with the seed and its cotton. This mixture is known as "unclean seed." If large quantities are to be handled, grain hammer-mills or other machines can be used. The seed is separated from the "cotton" by rubbing over a screen wire of small mesh, such as a window screen. This produces "clean" seed ready for sowing. Only about 20 percent of the seed actually handled is readily extractable; beyond this point, further rubbing yields so little seed that it is probably unprofitable.

The seed should be sown immediately after extraction. Its viability is greatly reduced in a few days by dry, open storage, although it may be safely kept for a week or more in moist, cold storage.

Seed Sowing. The best nursery soil is a fertile, fine sandy loam. A suitable arrangement is to have seed beds 4-feet wide and 1-foot alleys or paths between beds. The beds are formed by breaking out the alley with a middle-buster, then leveling off the bed surface with a rake or a drag.

The seed is sown on the surface of the bed by hand, either broadcast or in drills, 6 inches or more apart. The seed should not be covered. Broadcast beds are more easily sown and will produce more plantable trees per unit area owing to the better distribution of seed, but drilled beds are more easily weeded and may be cultivated. Cottonwood seed is so small that care is needed to obtain a uniform distribution of seed on the bed. Mixing the seed with a dry sandy soil will help, or sometimes "unclean" seed is sown so that the location of the "cotton" on the bed indicates the distribution obtained.

Fresh seed is highly viable, with 80 to 90 percent germination. Actual numbers of trees per 100 seeds sown will be much lower, for the young seedlings are so fragile that the slightest adversity in field conditions causes considerable loss. It is therefore wise to sow heavily to insure a fully stocked stand, and thin later to the desired density if the stand is overstocked. A good stand can generally be produced from 1 ounce of clean seed per 100 square feet of seedbed, or about 300 seeds per square foot. If drill-sown, 100 seeds per linear foot are adequate if well distributed.

Constant, ample moisture is required for germination and initial establishment of the seedlings. If an overhead sprinkling system is available, the beds should be wet before planting and kept continuously moist by frequent sprinkling. Equally good results may be obtained by irrigation, in which case the beds are first thoroughly soaked by flooding and then drained just enough to expose the surface on which the seeds are sown, preferably broadcast. Sufficient water is used to keep the alleys full, thus maintaining a saturated bed. This method is especially suitable for a small nursery, but requires a level site. The young seedlings should not be submerged, for development is then checked and more mortality will occur, especially on hot, sunny days.

The surface of the bed must be kept

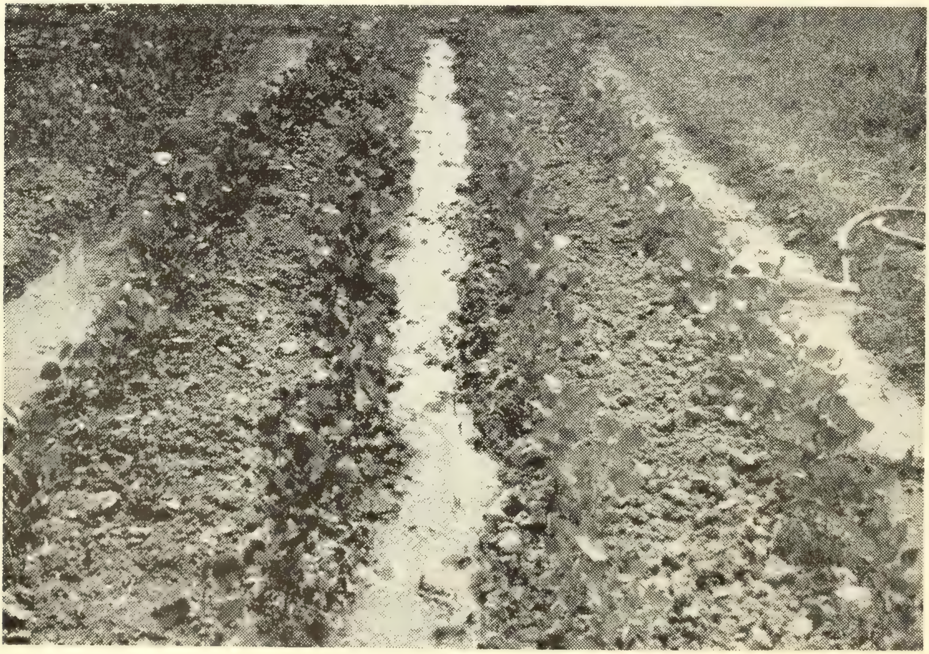

Figure 4. One-month-old cottonwood raised from seed in a nursery. Note arrangement of rows on the narrow bed and method of flooding the alleys to keep beds continuously moist.

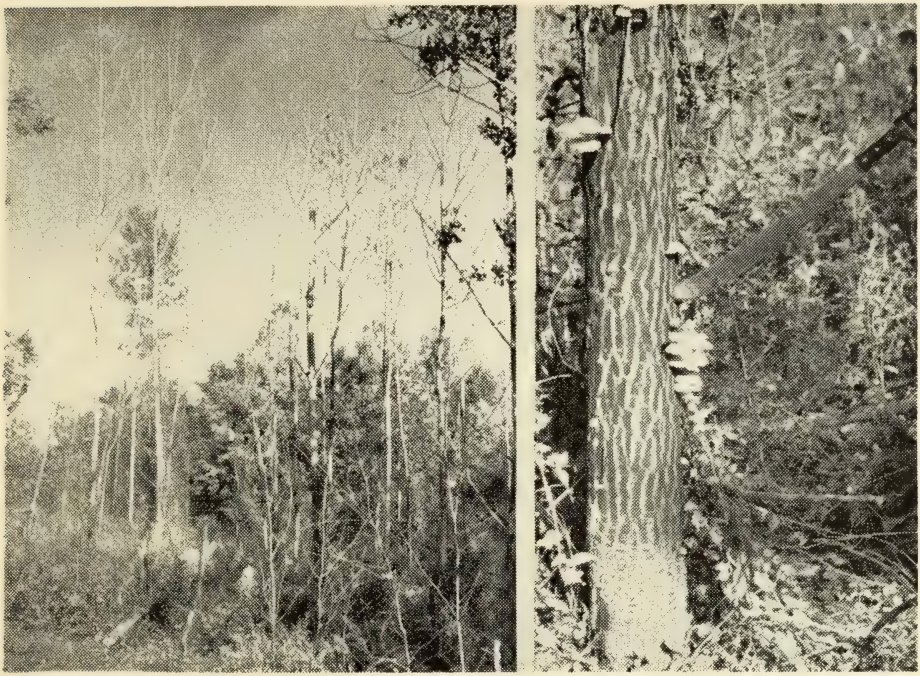

Figure 5. One year after a fast-burning summer fire ran through a 12-year-old cottonwood plantation. Left.—As the leafless branches indicate, nearly every tree is dead. Average tree d.b.h. was 6.5 inches and average height was 53 feet. The stand will be a total loss, since it is below merchantable size. Right.—Bark at the base of this fire-killed tree is loose, and wood-rotting fungi are fruiting all along the bole. Rapid decay makes prompt salvage cutting necessary if fire-killed trees are of merchantable size.

continuously moist for at least 3 days after sowing. Germination occurs within 12 to 24 hours after sowing. The seedling develops very slowly at first, but after about 3 weeks of growth accelerates steadily and rapidly.

Shades or screen help to conserve and maintain uniform surface moisture, but are needed only if sufficient moisture cannot otherwise be maintained. Half-shade provided by a screen made of laths stapled to wire is suitable.

If the beds are overstocked, the seedlings should be thinned when about 4 weeks old to approximately 20 trees per square foot. Subsequent cultural care during the growing season is the same as for most other tree species. The beds will need weeding several times, especially when the seedlings are small. This involves hand-picking if the seeds were broadcast, but may be largely done with a hoe if the seeds were drill sown. The trees should be watered generously during the summer, either by overhead sprinkling or by irrigation (fig. 4).

Cost of establishing a nursery from seed will be materially greater than that of establishing one from cuttings.

Protection

Cottonwood plantations must be protected against fire and grazing. They should also be closely examined for disease, insects, and other damage.

Fire

Even a very light burn will kill young cottonwoods. Larger trees are a little more resistant but those that do survive become badly scarred and soon develop serious butt rot. Even one fire of moderate intensity can kill trees 6 to 10 inches in d. b. h. (fig. 5). All this emphasizes the need for fire protection in natural stands of cottonwood as well as in plantations. Where natural firebreaks like roads, trails, and sloughs do not break up the area into approximately 40-acre blocks, 15-foot fire lines should be plowed. There should also be firebreaks around the boundaries of the stand or plantation.

Grazing

Cattle and other livestock seriously damage the small cottonwood trees by trampling and browsing at all seasons of the year. Where deer are numerous, young trees are likely to be stripped of their bark in the winter and of their early leaves in the spring, when other deer food is scarce. Both livestock and deer kill many trees and cause others to be weakened or to have multiple sprouts. Livestock should be fenced out before cottonwood is planted. Deer damage to fruit trees has been controlled by spraying the trees with repellents, but these preparations do not appear to have been tested on cottonwood.

Rodents

Rabbits gnaw the bark of some small trees in winter, sometimes completely girdling them. Usually the trees sprout again, but often with reduced vigor; at best one or more seasons' growth is lost. Repellents have been partially effective, but except where heavy damage is expected, it is doubtful if the added expense is warranted. An effective rodent repellent can be made by stirring 5 pounds of liquid asphalt paint into 3-1/3 quarts of water and adding 3-1/3 pounds of copper carbonate, and enough water to make up 4 gallons. This mixture is sprayed on the cuttings after planting.

Insects

Damage by several insects has been observed in the Stoneville plantations. None has been calamitous, but all plantations should be carefully watched for unusual infestations. Ants and aphids together are frequently present around the terminal buds and upper leaves of the less vigorous one- or two-year-old trees, but aside from retarding growth slightly they apparently do little damage. Aphids of the species **Pemphigus populi-transversus** are found in the plantations almost every year and occasionally become so numerous that the stem of practically every leaf bears a gall caused by them. The damage is negligible even when infestation is heavy.

Small greenish false-caterpillars with dark spots along the back and sides (larvae of the sawfly **Pteronidea populi**) commonly feed on the leaves of young cottonwoods in the early fall. Defoliation may be quite severe, but occurs so late in the season that it does not retard tree growth.

Damage by borers in the young cottonwood plantations at Stoneville has not been severe, but two species have been present every year both in the nursery and field plantings. The aspen borer (**Saperda calcarata**) is a yellowish beetle larva from 1 to 2 inches long. The borers kill a few trees by working just below the bark and girdling the stem. More damage is done, however, by the rot which spreads from old galleries and causes the trees to break off. The carpenter worm (**Prionoxystus robiniae**) is a brown-headed reddish-white caterpillar from 2 to 3 inches long. It tunnels in the wood, forming burrows up to ½ inch in diameter which deform the tree, weaken small stems, and degrade the product of mature trees. Fortunately the insect rarely attacks mature trees.

No borer control measures are economical enough for large scale use. Borers seem to concentrate their attack on the poorer sites and the weaker trees in the stand, so that any cultivation or other practice which produces healthy, vigorous trees reduces likelihood of damage. In plantations with an exceptionally heavy infestation, it is probably wise to cut and burn the infested trees. All cuttings gathered for planting should be examined to exclude and destroy those which contain borers.

The common grasshopper (**Melanoplus** spp.) feeds on the bark of one- to three-year-old trees in the late summer and early fall. This injury is seldom serious.

Disease

No important disease has as yet been observed on cottonwood plantings. The poplar canker (**Cytospora spp.**) frequently kills some of the less vigorous and weakened young trees. It is most noticeable on the poorer sites where growth is slow. Mortality usually occurs in late fall or winter after growth has practically ended for the season; the inner bark on the main stem is attacked and killed first. This canker is very common, and lives either on dead wood or live wood of low vitality. The only remedy seems to be to avoid the poorest sites and to cultivate or release trees before growth is seriously retarded.

Defoliation of cottonwood trees of all ages may be caused by a rust fungus of the genus **Melampsora**. The rust forms yellow spores on the lower side of the leaves, and dead leather colored patches on the top. Slight evidences of this disease are noticeable practically every year. Occasionally it almost completely defoliates some trees. Such intermittent defoliation does not kill the trees, but slows their growth. Trees defoliated in midsummer sometimes put on new leaves the same season. There are no satisfactory control measures, but fortunately damage is not severe enough to endanger the success of a plantation.

Cottonwood may be defoliated by drifting cotton defoliation dusts or 2,4-D sprays. Sub-freezing weather and repeated ice storms produce frost cracks in the stems and break the limbs. Where winter damage is followed by spring or summer drought, trees two to five years old may die or become very weakened. Such a plantation may look hopeless especially when grasshoppers go to work on it. Fortunately, this combination of circumstances is rare, and the return of normal weather will restore most of the trees to normal vigor.

Costs and Returns

The costs of establishing cottonwood plantations as reported in this bulletin are based on average agricultural wage rates and equipment rental charges for the year 1950. Equipment rental includes allowances for interest on the capital invested and for depreciation. Besides wage rates, the important variables in planting costs are: (1) condition of the planting site and intensity of site preparation; (2) availability of planting stock; (3) frequency and intensity of cultivation; and (4) spacing. Table 4, prepared from actual time records, reflects an average cost per acre of planting and caring for cottonwood during the first growing season, employing the best cultural practices now known for two major site conditions.

Since there are no mature cottonwood plantations in the Yazoo-Mississippi Delta, returns must be estimated from information on natural stands. Net returns will vary with many circumstances, but the examples given below indicate that potential profits may be large.

In fully-stocked stands of cottonwood on good sites, the trees should average 20 inches d. b. h. at 35 years of age[6], and the total yield in logs scaling 12 inches and larger would be approximately 27,500 board feet per acre, Doyle rule. This amounts to $275 per acre if a stumpage rate of $10 per thousand board feet is assumed. However, at about 35 years, the stand would be in its period of greatest growth in value.

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[6] Tree sizes and per acre volumes in this discussion are for pure, fully-stocked natural stands in the Mississippi Valley and were taken from Williamson, A. W., **Cottonwood in the Mississippi Valley**. U. S. Dept. of Agr. Bul. 24, 62 pages 1913.

If it were held 7 years longer, a maximum total yield of approximately 29,500 board feet per acre can be attained. This larger timber—the average diameter will be about 23 inches—should command a higher stumpage rate than $10 per thousand board feet. If a stumpage price of $15 is assumed, the return would be $442.50 per acre. Table 5 estimates the per-acre expenditures necessary to obtain such returns for land where site preparation can be done by disking. Where site preparation must be done with a fireline plow, the planting costs in the table must be increased by $8.00.

Cash outlay for the various site conditions and plantation ages therefore could range from $18.50 to $46.10 per acre. The net returns might range from $220 to $410 per acre. These figures are conservative, since they are based on final volumes attained in unmanaged stands with no returns from intermediate thinnings. Under management there will be several intermediate cuts to take out the trees about to die of over-crowding, and pulpwood can be secured from small trees and the tops of sawlog trees. Approximately 30 cords of pulpwood per acre, worth at least $1.00 per cord, might be thus obtained.

The first thinning will be needed when the plantation is about 12 to 15 years old. The products from the thinning will be largely pulpwood. Another thinning prior to the harvest cut in the forty-second year would include some small saw timber which would be lost in unmanaged stands. Acceleration in growth of trees released by thinning is a benefit which is not included in the figures given.

Interest on capital or discount on deferred returns has been ignored in the rough estimates above. However, well over 4 percent can be earned on the total investment when land is carried at $15 per acre, even with planting costs at $23 per acre and annual expenditures at 50 cents per acre for taxes and 5 cents per acre for protection. Because of its quality

Table 4. Costs per acre of planting and cultivating cottonwood

Operation	On sub-marginal agricultural land, 9- by 9-foot spacing (538 trees per acre)	On vine-covered woods sites, 6- by 10-foot spacing (726 trees per acre)
	Dollars	Dollars
Site preparation		
Removing logs and down trees from strips*	..	3.80
Plowing strips with Mathis four-disk plow		8.15
Cross-disking entire area	2.05	......
Planting stock		
Raising cuttings in nursery	.30	.40
Harvesting and preparing cuttings	1.30	1.75
Planting**	1.75	2.20
Cultivation		
Two cultivations astraddle the strip with wheel tractor	......	1.84
Cross-disking twice with wheel tractor	4.15	......
Hoeing around trees once during season	5.00	5.00
Total	$14.55	$23.14

*Necessary only where much heavy debris is present. Strips can be made to bypass occasional obstacles.

**If 2 ounces of fertilizer are used per tree, cost of fertilizer and application will be $4.30 per acre for 9-by 9-foot spacing and $5.95 per acre for 6- by 10-foot spacing.

Table 5. **Per-acre expenditures for 1 acre of planted cottonwood on sites prepared by cross-disking, disregarding interest charges.**

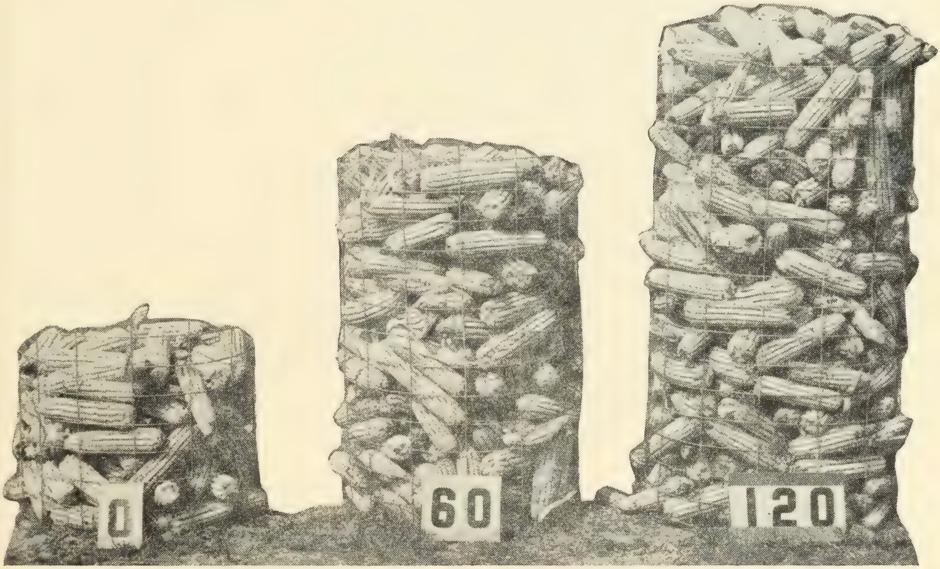
Item	Age at final harvest	
	35 years	42 years
	Dollars	
Planting and first-year care (538 trees per acre)	15.00	15.00
Taxes		
50 cents annually for land protected by the levee or 5 cents annually for unprotected batture land	17.50 or 1.75	21.00 or 2.10
Protection from fire and grazing an average of 5 cents annually	1.75	2.10
Total	34.25 or 18.50	38.10 or 19.20

increase, the 42-year rotation should show a slight advantage over the 35-year rotation.

Cottonwood planting has passed the experimental stage. It is ready to take its place as one of the standard land-management techniques of the bottomlands of the large southern rivers. One of its most appealing features is that it puts into production land generally unsuited for other crops. Even sites densely covered with vines may be profitably planted, and the batture land, because of its fertility and low taxes, is the most remunerative of all. As experience with large-scale planting reduces the cost of establishment and cultivation, investments in cottonwood plantations should become still more attractive.

BULLETIN 486 DECEMBER 1951

Fertilizer and Production Practices For Corn In The Hill Sections Of Mississippi



MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
CLAY LYLE, Director
STATE COLLEGE MISSISSIPPI

RECOMMENDATIONS

As the result of a series of field experiments conducted in Mississippi since 1945, the following recommendations are made for corn:

1. Fertilization: In the hill and delta foot hill sections apply at planting time 300 pounds of 12-8-8, 500 pounds of 8-8-8, or 600 pounds of 6-8-8, per acre depending on needs as shown by a soil test. Side dress with 60 to 90 pounds of nitrogen per acre. (In the delta section apply 90 to 120 pounds of nitrogen per acre in onepre-planting or in split applications.)
2. Leave plants 15 inches apart in 42-inch rows or 16 inches apart in 40-inch rows. This stand aggregates approximately 10,000 plants per acre. From 9 to 14 pounds of planting seed will be required—a little less than one peck.
3. Variety: Plant an adapted hybrid. For specific recommendations see Figure 3.
4. Planting: Prepare a good seed bed on well-drained soil. Plant just before cotton planting time.
5. Cultivation: Practice shallow cultivation until the corn is knee high. Avoid late or deep cultivation.

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Fertilizer and Production Practices for Corn in the Hill Sections of Mississippi

By HOWARD V. JORDAN

Fertilizer and management recommendations for corn in Mississippi have changed greatly in the years since World War II. This is strikingly illustrated by comparing the recommendations in 1944 (Mississippi Experiment Station Circular No. 120) with those of the present. The 1944 recommendations were for the application of from 24 to 32 pounds of nitrogen per acre for corn. On most soils phosphoric acid and potash were found not to increase yields and no mention was made of hybrids. Plant stands, which were usually about one plant every three feet in the row, or about 4,000 plants per acre, were not discussed. The average corn yield in the State for the decade 1935-44 was only 15.3 bushels per acre.

The recommendations in this bulletin, which supercedes Circular 120, call for much heavier fertilizer applications, including the use of complete fertilizers for soils of the hill section. The wide spacing of plants used prior to 1944 restricted the use of very high fertilizer rates, but stands of 10,000 plants per acre are now advocated. Adapted hybrids are recommended because of their greater inherent yielding capacity. These practices, when combined, have produced an average yield of 72 bushels of corn per acre in experiments well distributed over the hill section of the state in the past five years.

Closely following these changes in recommendations there have been equally striking changes in farm practices with this crop. With as yet only partial acceptance, the average State yield has gradually increased since 1945, to 27 bushels per acre in 1950. This represents a rise of 76 per cent over the 1935-44 average. There were 1303 certified yields of 100 bushels or more per acre in 1950.

Present recommendations have evolved from a series of field experiments with supporting laboratory and greenhouse tests, which are described in this bulletin.

Nutrient Requirements for Corn

Certain background information should be considered in connection with these experiments. A 100-bushel crop of corn requires 160 pounds of nitrogen, 55 pounds of phosphoric acid, and 110 pounds of potash per acre; these nutrients must be supplied by the soil or in fertilizer. If any one of these nutrients is inadequate, yields are reduced. Moderate to serious shortages produce characteristic symptons in the deficient plants which aid in diagnosing nutritional troubles.

CORN RESEARCH IS COOPERATIVE PROJECT IN MISSISSIPPI

The research on which this publication is based was conducted as a cooperative project between the Mississippi Agricultural Experiment Station and the Division of Soil Management and Irrigation, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration, U. S. Department of Agriculture. The following individuals cooperated in the studies:

Howard V. Jordan, soil scientist, U.S.D.A.

S. P. Crockett, superintendent, North Mississippi Branch Station, Holly Springs.

J. F. O'Kelly, agronomist, Mississippi State College, State College.

Louie Walton, Superintendent, Black Belt Branch Station, Brooksville.

Roy Kuykendall, superintendent, and B. C. Hurt, formerly agronomist, Coastal Plains Branch Station, Newton.

Ray H. Means, formerly superintendent, and S. L. Wedgworth, formerly agronomist, Brown Loam Branch Station, Oakley.

T. E. Ashley, superintendent, South Mississippi Branch Station, Poplarville.

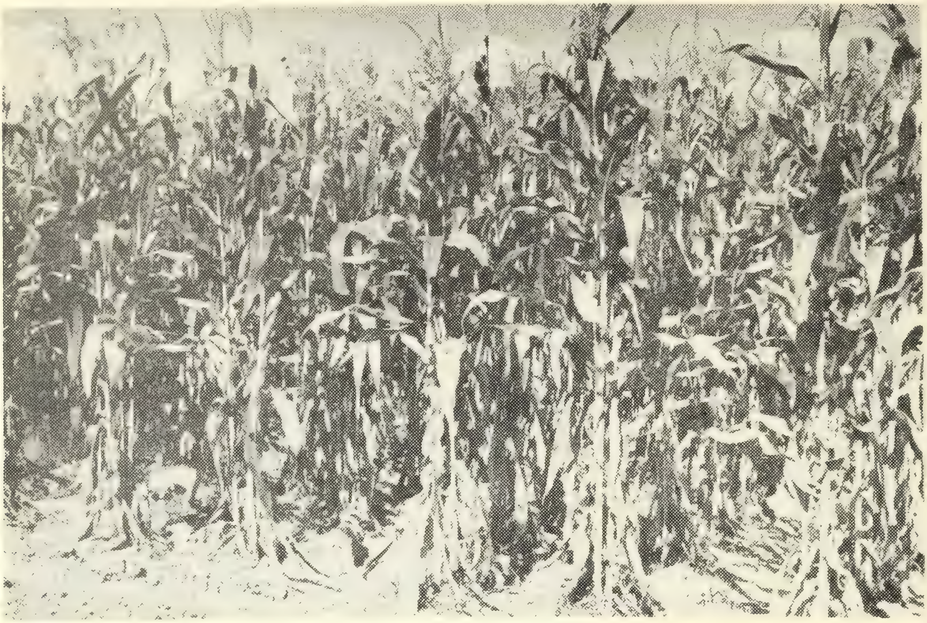
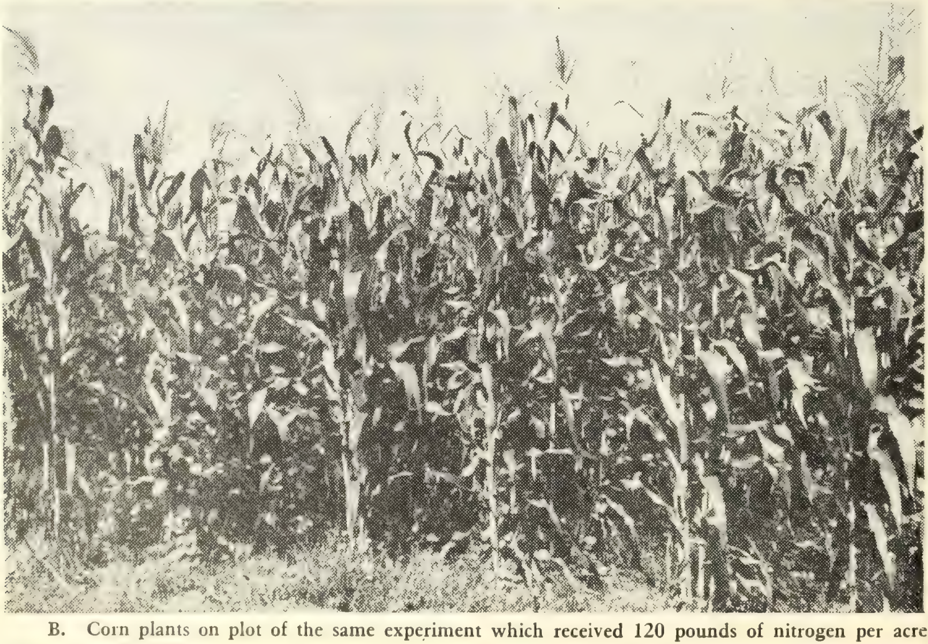


Figure 1. View of two plots in an experiment at State College. Both photos were made July 20, 1949.

A. Corn plants on an experimental plot which received 60 pounds of nitrogen per acre. Note firing of lower leaves.



B. Corn plants on plot of the same experiment which received 120 pounds of nitrogen per acre. Note absence of firing.

It is evident that nitrogen is the nutrient required in greatest abundance for corn. Further, 60 to 70 percent of the nitrogen absorbed by the corn crop is contained in the harvested grain and is thus removed from the land. Mississippi soils are more generally and more seriously deficient in nitrogen than in the mineral nutrients.

Symptons of nitrogen deficiency in corn are stunted plants and a yellowing of the leaves. Yellowing occurs first in the older leaves and follows the midrib from the leaf tip to the point of attachment, frequently showing a V-shaped pattern. The affected leaves dry or "fire" as shown in Figure 1a. This plot received 60 pounds of nitrogen per acre. The leaves did not fire in an adjoining plot receiving 120 pounds of nitrogen which is shown in Figure 1b.

Insufficient supplies of phosphorus cause stunted plants with purplish leaves, particularly in the early stages. After the plants are two to three feet high their greater root spread may enable them to absorb adequate amounts of phosphorus, and if the deficiency is not too acute the corn may resume normal growth. From 60 to 80 percent of the phosphorus absorbed by the crop is lost from the soil in the harvested grain.

A deficiency of potash is shown by scorching of the the leaf margins. Plants are weak and there may be excessive lodging. The tips of the ears do not fill with normal-sized grains. In contrast with nitrogen and phosphoric acid, most of the potash absorbed by the plant remains in the stems and leaves. Only about 10 to 25 percent of the potash is removed in the harvested grain.

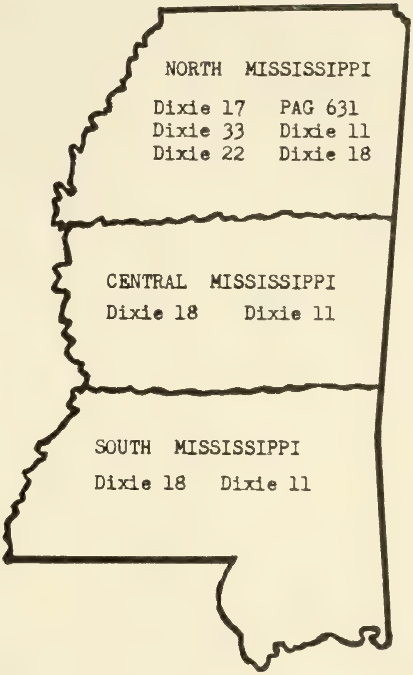


Figure 2. Hybrids recommended for the different areas of Mississippi.

If corn is fertilized to produce 100 bushels per acre there must be adequate plants to utilize the nutrients supplied, otherwise some of the fertilizer will not be used to full advantage. Hybrids[1] adapted to all parts of Mississippi are now available and should be grown in order to capitalize fully on good production practices. The hybrids recommended for the different areas of Mississippi are shown in Figure 2.

Scope of Experiments

In the past five years experiments have been conducted in each of the major soil areas in the hill section of the State, largely in cooperation with Branch Experiment Stations. A few additional trials were conducted with cooperating farmers.

The general plan of all of the experiments was similar. Nitrogen at rates ranging from 0 to 120 pounds per acre was applied to stands of 4,000, 8,000, and 12,000 plants per acre. In a few experiments applications were raised to 150 pounds of nitrogen and 16,000 plants per acre. These treatments were made on plots that received no minerals, on plots that received phosphoric acid in addition to the nitrogen, on plots that received potash in addition to the nitrogen, and on plots that received nitrogen, phosphoric acid, and potash in combination.

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[1] More complete discussion of hybrids and their adaptations are contained in annual variety tests results published by the Mississippi Experiment Station.

The experiments, covering such a wide area and of five years' duration, encountered extremes of weather conditions from too wet to too dry, in addition to nearly normal seasons. This range in conditions caused some variation in seasonal or local crop responses; nevertheless, the general results are rather consistent.

The results are summarized in Appendix Table 1. Due to space limitations this summary includes only a few of the many treatments in the experiments. These treatments were selected as being common to most trials and because they cover the range from low-fertility to high-fertility treatments.

As a general average the yield was increased from 22 bushels with no nitrogen and 4,000 plants per acre to 72 bushels with 120 pounds of nitrogen and 12,000 plants per acre. This represents an increased yield of 50 bushels of corn per acre for the application of 120 pounds of nitrogen and the adoption of better management practices. In addition, there are a number of other, incidental, advantages which are discussed in subsequent pages.

The results of a number of the experiments are presented in greater detail to illustrate factors involved in these newer methods of corn production.

A Typical Experiment

An experiment conducted on Kaufman fine sandy loam on the Main Station at State College for four years, 1947 to 1950 inclusive, is considered to be typical of the studies and will be discussed. There were four replicates, and the treatments were directly superimposed on the same plots each year. In this experiment adequate phosphoric acid and potash were supplied in all treatments, and nitrogen and stand rates were varied as shown in Table 1, which also records the yields for the four-year period.

With the once-prevalent 4,000-plant stand the addition of 60 pounds of nitrogen increased the mean yield for the four-year period from 29.4 to 64.7 bushels per acre. The application of a second 60-pound increment, to a total of 120 pounds of nitrogen per acre, however, gave an increase of only about four additional bushels. The stand in this case limited the yield to about 68 bushels regardless of very high rates of fertilization.

With the 12,000-plant stand there were sufficient plants to utilize the full 120 pounds of nitrogen. The four-year average yield with 120 pounds of nitrogen and 12,000 plants per acre was 105.5 bushels per acre.

The results of this experiment, in common with others over the State, emphasize the importance of balancing fertilizer applications and plant stands. One hundred to 120 pounds of nitrogen and 10,000 to 12,000 plants per acre have proved a very satisfactory combination in these experiments.

Table 1. Yields of corn in fertilizer-spacing experiment at State College, 1947-1950.

Treatment		Acre yields of corn				
Nitrogen	Plants	1947	1948	1949	1950	Mean
lbs./acre	No./acre	Bu.	Bu.	Bu.	Bu.	Bu.
0	4,000	31.4	29.3	21.2	35.8	29.4
60	4,000	54.3	71.4	64.5	68.9	64.8
120	4,000	56.0	73.7	67.9	77.3	68.7
0	12,000	22.4	36.3	33.7	47.6	35.0
60	12,000	61.8	77.6	71.2	90.2	75.2
120	12,000	96.2	103.4	100.4	121.8	105.5

Table 2. Yields of corn, weights per ear, number of ears per plant, and grain:stover ratios in fertilizer-spacing experiment. Caledonia, Mississippi. 1946.

Treatments		Acre yield of corn	Weight per ear	Ears per plant	Grain: stover ratio
Nitrogen	Plants				
lbs./acre	No./acre	bu.	lbs.	No.	
0	4,000	21.0	0.31	1.11	1:1.57
60	4,000	55.5	0.40	2.31	1:1.15
120	4,000	67.1	0.44	2.53	1:0.84
0	12,000	14.3	0.12	0.64	1:4.67
60	12,000	52.8	0.29	1.01	1:1.42
120	12,000	81.8	0.35	1.31	1:0.97

Table 3. Yields of corn in the fourth year (1948) of a fertilizer-spacing experiment at the North Mississippi Branch Station showing the response to phosphoric acid and potash.

Treatment		Acre yields of corn		Increased yield for P and K
Nitrogen	Plants	Without P or K	With P and K	
lbs./acre	No./acre	bu.	bu.	bu./acre
		Former farm practice		
0	4,000	14.1	19.8	5.7
30	4,000	28.3	34.0	5.7
		High-fertility treatments		
60	12,000	49.8	57.6	7.8
90	12,000	55.9	72.3	16.4
120	12,000	63.2	95.8	32.6

Size and Number of Ears per Plant, Grain:Stover Ratios

Changing the nitrogen and stand rates has other, very consistent, effects on plant characteristics.

As the rate of nitrogen application is increased, both the size of the individual ears and the number of ears per plant are increased. Increasing the plant population has the opposite effect. Thus these two factors compensate each other, and ears of satisfactory size and number are produced when nitrogen and stand rates are kept in balance.

Similarly as the rate of nitrogen application is increased, a pound of grain is produced from progressively smaller amounts (weights) of leaves and stems. The tendency is thus to produce more efficient plants. Conversely as the stand rate is increased the weight of leaves and stems required to produce a pound of grain is increased. Again, however, these effects are complementary, and balanced nitrogen-stand rates produce corn with a very favorable grain:stover ratio approximating 1:1. Data showing these effects are presented in Table 2. These data were obtained in an experiment conducted on Tilden fine sandy loam on the F. L. Honnoll farm at Caledonia in 1946.

Response to Phosphoric Acid and Potash

A few soils have been encountered in the hill section of the State that respond to applications of phosphoric acid and potash even with low planting rates and moderate nitrogen fertilization. For the most part, however, the pre-1944 finding that phosphoric acid and potash do not generally increase corn yield still applies **when stands are maintained at approximately 4,000 plants per acre and nitrogen fertilization is moderate.**

When plant stands and nitrogen applications are increased, however, the need for these minerals soon becomes evident, and is sometimes acute. The mineral deficiencies become progressively more severe as intensive cropping is repeated in successive years. This is apparent in data from an experiment at the North Mis-

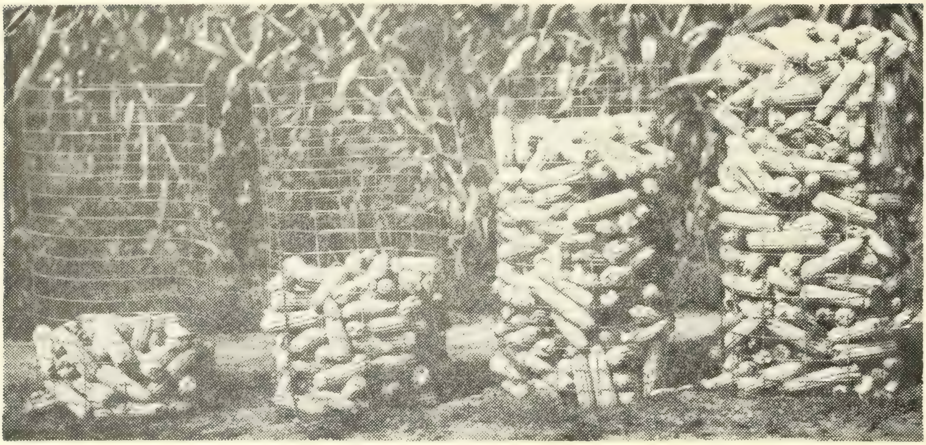

Figure 3. Results of an experiment at the North Mississippi Branch Station in 1946. From left to right the baskets of corn represent treatments and yields as follows:

Treatment	Yield—bu./acre
No nitrogen	17.8
Vetch nitrogen	30.3
Commercial nitrogen, 80 lbs./acre	67.4
Vetch plus 80 lbs. commercial nitrogen	74.0

sissippi Branch Station, reported in Table 3. These data are for 1948, which was the fourth year of the experiment. Phosphoric acid and potash caused an increase of only 5.7 bushels of corn per acre under the low-fertility system but increased the yield by 32.6 bushels per acre on the most intensively cropped plots.

This pattern has been quite consistent in experiments in the hill section of the State. Accordingly a complete fertilizer at planting time is recommended for these soils.

Soil Test Best Guide to Mineral Requirements

Recommendations published herewith are generalized for the hill section of the State. They cover a considerable range in phosphoric acid and potash contents. More specific recommendations in the form of the particular ratio from among those listed can best be made for a specific field on the basis of a soil test. Such a test will be made without charge for residents of Mississippi if a soil sample is submitted to the Soil Testing Laboratory at State College. County agents and other agricultural workers will advise regarding this service.

Value of Green Manuring Crops

A part of the nitrogen needed by corn may well be supplied by winter cover crops. The results of experiments in Mississippi[2] have shown that good green-manure crops of hairy vetch, wild winter peas, or Giant burclover will increase crop yields as much as will 30 or 40 pounds of commercial nitrogen. The results of an experiment conducted on Grenada silt loam at the North Mississippi Branch Station in 1946 are shown pictorially in Figure 3.

When cover crops are grown in the winter, preceding corn, it is recommended that they be turned under at least three weeks prior to planting. If this precaution is not followed insects may deplete the stand and cause considerable injury to young corn.

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[2] Mississippi Agricultural Experiment Station Service Sheets 382, 386, 414. Mississippi Farm Research June 1946, P4. Mississippi Farm Research October 1948, P7.

Perennial leguminous crops, grown in rotation with corn, have special values where they can be adapted in the cropping system. In addition to the nitrogen and organic matter they supply, many of these crops have deep fleshy root systems which loosen and deepen the soil.

Kudzu was grown for four years in an experiment at the North Mississippi Branch Station on Loring silt loam. In one series of kudzu plots the tops were removed for hay and only the roots and stubble accumulated over the four-year period. In another series of plots both tops and roots of the kudzu were disced in each fall during the four years. There were plots which grew corn continuously throughout the period. All plots were planted to corn in 1950 and the yields are shown below:

Continuous corn	19.4 bu. per acre.
Kudzu, hay removed	87.8 bu. per acre
Kudzu, tops and roots turned	102.1 bu. per acre

A part of the increase in yield on kudzu plots in this experiment is attributed to the effect of the roots on physical soil properties. The improvement may be expected to persist over several years; the residual effects are now being measured. Legumes other than kudzu that have similar rooting habits, such as alfalfa, sweetclover, and sericea lespedeza, have similar potentialities.

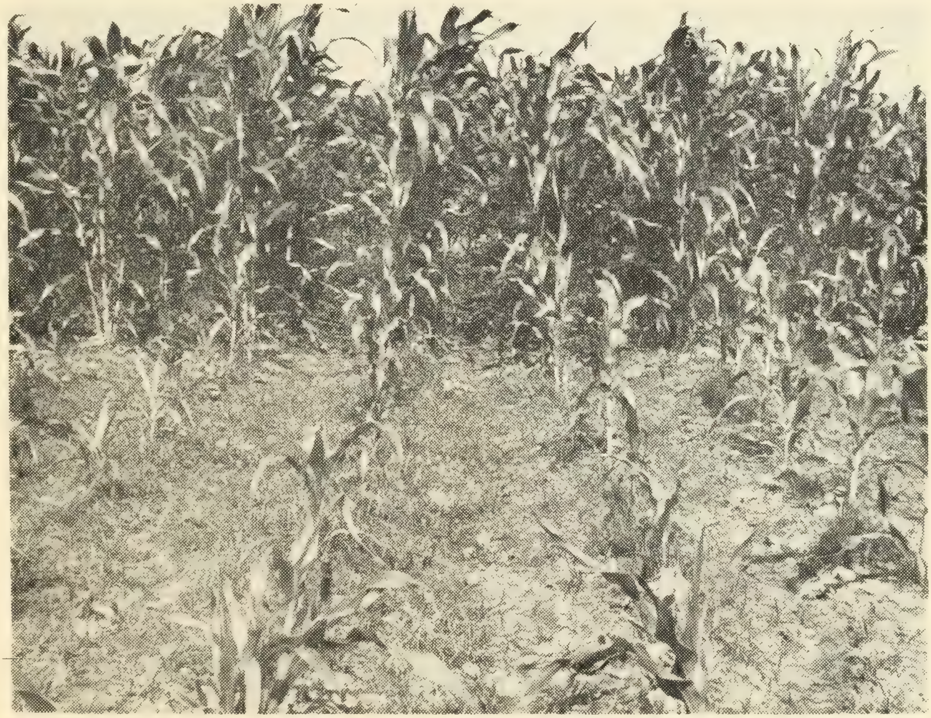

Figure 4. View of two treatments in an experiment at State College. Photographed June 30, 1949. Plot in foreground received no nitrogen and had 4,000 plants per acre. The yield was 21.2 bushels. Plot in background received 120 pounds of nitrogen and had 12,000 plants. The yield was 100.4 bushels. Note grass and weeds in foreground; these are shaded out by corn in the background.

Table 4. Protein[1] content of corn grain from fertilizer-spacing experiment at State College.

Treatment		Protein content of grain			
Nitrogen	Plants	1948	1949	1950	Mean
lbs./acre	No./acre	%	%	%	%
0	4,000	8.30	8.28	8.15	8.24
60	4,000	10.06	9.21	10.10	9.79
120	4,000	10.66	10.43	11.46	10.85
0	12,000	7.53	7.83	7.50	7.62
60	12,000	8.93	8.39	8.67	8.66
120	12,000	9.94	9.88	10.11	9.98

[1] N x 6.25 on dry weight basis.

High-Fertility Treatments Have Other Advantages

These newer methods of growing corn have a number of advantages which are entirely incidental to their higher yield potential.

An Aid to Weed Control. Well-fertilized, thickly-spaced corn produces a dense vegetative canopy early in the season. One effect of this is to "shade out" many of the weeds and grasses normally present in Mississippi corn fields. This is evident in Figure 4. The experiments have shown that corn can be produced with one less cultivation under the high-fertility system than with the former stands and fertilizer rates.

It has been found advisable to cultivate corn shallow and flat until it is about knee high, and then to discontinue cultivation entirely. Subsequently only the most persistent and hardy weeds are likely to be troublesome in the high-fertility corn.

Nitrogen Increases Protein in Corn. Corn is primarily a carbohydrate or energy feed, but it contains an appreciable and valuable amount of protein. The protein in commercial corn has declined in the past decade, probably due to the production of larger yields without applying sufficient nitrogen.

In these experiments application of nitrogen fertilizer increased the protein content of the grain. Conversely increasing the plant stand reduced the protein content. When nitrogen rate and plant stand were increased in balanced proportions, however, the corn had a higher protein content than that produced under the low-fertility system. This is shown by the data in Table 4. A similar pattern is evident in the protein content of leaves and stems; thus in so far as corn stalks are used for silage or for direct feeding in other forms, the high-fertility corn would have considerable advantage.

High - Fertility Treatments Increase Crop Residues. As a further advantage, the high-fertility treatments produce large amounts of crop residues, in the form of leaves and stems, for incorporation with the soil. These residues were weighed and analyzed for nitrogen in the experiment at State College, with results shown in Table 5.

Table 5. Dry weights and nitrogen contents of crop residues returned to soil in fertilizer-spacing experiment, State College.

Treatment		Crop residues returned to soil annually	
Nitrogen	Plants	Dry weight	Nitrogen content
lbs./acre	No./acre	lbs./acre[1]	lbs./acre[2]
0	4,000	2009	8.6
60	4,000	4122	19.3
120	4,000	3996	20.1
0	12,000	3296	13.0
60	12,000	5475	21.6
120	12,000	6643	32.1

[1] Mean of three years.
[2] Mean of two years.

Comparing the lowest- with the highest-fertility treatment (first and last treatments in Table 5) there is an advantage in annual accretions of more than two tons of organic material and 23.5 pounds of nitrogen per acre for the highest rate of nitrogen and the heavier stand. This additional organic material has considerable value for reducing erosion and improving the tilth of the soil.

For best utilization of these residues it is recommended that they be cut with a stalk cutter or lightly disced in to the soil in the fall. In this way they are left in or on the surface to protect the soil during the winter.

Advantages of High-Fertility System: A Summary. The direct and incidental advantages of growing corn by the newer practices are brought together in Table 6. For this purpose the four-year results in the experiment at State College are used, and comparisons are made between a low-fertility and a high-fertility system.

Stated briefly the yield was increased by 76.1 bushels per acre and the fertilized corn had higher protein content. The increase in protein per acre was equivalent to that in more than 1000 pounds of cottonseed meal. There was an increase in annual return of crop residues amounting to more than two tons per acre, dry weight, and the residues from the fertilized corn had higher nitrogen content. This was accomplished with a saving of one cultivation for the season.

Economics of High-Fertility Corn Production

These newer methods of growing corn are profitable. This is shown by a study[3] of production costs made in cooperation with the Department of Agricultural Economics. Average yields in the experiments for the five-year period (Appendix Table 1), and current prices for corn and

Table 6. Summary of advantages for high-fertility method of growing corn. Experiment at State College, 1947-1950, inclusive.

Item	TREATMENT		
	N:	0	120
	Plants:	4,000	12,000.
Yields of corn, bu./acre:		29.4	105.5
Incidental advantages:			
Protein content of grain, %:		8.24	9.98
Annual return of crop residues, lbs./acre:		2,009	6,643
Nitrogen in crop residues, lbs./acre/year:		8.6	32.1
Cultivations required, No.:		4	3

Table 7. Yields, value, production costs, and profits from growing corn with several management practices.

Item	Nitrogen applied per acre, pounds:	0	60	120
	Plants per acre, number:	4,000	8,000	12,000
1	Acre yield of corn, bushels:	22	52	72
2	Value of corn:	$33.00	$78.00	$108.00
3	Total production expense (as below)	13.84	26.58	36.27
	Land rental:	5.00	5.00	5.00
	Tractor and equipment cost:	7.26	9.80	12.64
	Seed:	0.24	1.60	2.24
	Fertilizer	1.34	10.18	16.39
4	Returns to management and labor (2-3):	19.16	51.42	71.73
5	Labor cost at $.40 per hour:	5.12	9.28	12.48
6	Returns to management (4-5):	14.04	42.14	59.25
7	Production cost per bushel of corn (3 + 5 divided by 1):	0.86	0.69	0.68

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[3] D. W. Parvin, Associate Agricultural Economist cooperated in this phase of the study.

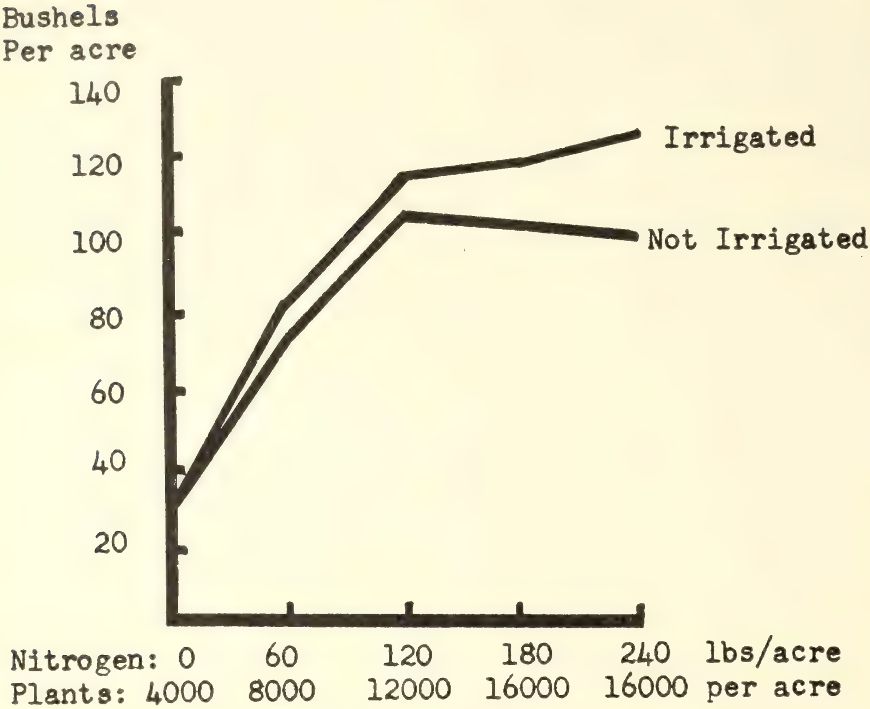

Figure 5. Yields of corn with various nitrogen applications and stand rates on irrigated and non-irrigated plots. Experiment at State College, 1950.

fertilizer materials were used. The study is summarized in Table 7.

The no nitrogen-4,000 plants per acre treatment produced an average of 22 bushels per acre at a cost of $0.86 per bushel. With the highest-fertility treatment the yield was 72 bushels per acre and the production cost was $0.68 per bushel. Returns to management or profits, after deducting all costs including labor, were $14.04 and $59.25 per acre respectively under the two methods of production.

Supplemental Irrigation for Corn

Yields in these experiments have generally increased from the no nitrogen-4,000 plant stand combination to the 120-pound nitrogen-12,000 plant stand treatment. With even higher nitrogen rates and thicker stands there were some further increases in yield, but the rate of return per pound of nitrogen was usually reduced (Appendix Table 1). Several factors contribute to this apparent limitation on higher yields.

The water requirement per acre of well-fertilized, thickly-spaced corn is several fold greater than that required by poorly fertilized, thinly spaced corn. In measurements at State College in 1948 it was found that moisture in the surface foot of soil was reduced to the wilting point by about June 30 in a 120-pound nitrogen-12,000 plant stand treatment while this point was not reached until early August under a 4,000-plant stand with the same fertilizer. Available moisture to a depth of three feet was virtually exhausted by July 10 in the high-fertility treatment, but never was completely exhausted under the 4,000-plant stand. From these studies it seems that available soil moisture may be the first limitation on higher corn yields as fertilizer rates and stands are increased greatly above the levels generally favorable in these experiments.

With this background, a study of the possibilities in supplemental irrigation for corn was initiated in 1950.[4] Water was supplied from a field pond through an overhead sprinkler system. In the experiment there were four replicates of irrigated and non-irrigated systems. Within each of these, nitrogen rates were varied from 60 to 240 pounds per acre, and stands were adjusted at 8,000, 12,000 and 16,000 plants per acre.

Distribution of rainfall in 1950 was quite favorable for corn, and there were only two incipient dry periods. The irrigated plots were irrigated on June 26 and July 31; because of subsequent rains the latter irrigation was probably of limited effectiveness.

The effects of nitrogen levels, stand rates, and supplemental irrigation on yields of corn are shown graphically in Figure 5. On non-irrigated plots yields increased in almost linear fashion to the 120-pound nitrogen-12,000 plant stand combination, which yielded 105.1 bushels per acre. As the stand was increased to 16,000 plants per acre there was a small reduction in yield even though the nitrogen rate was increased concurrently. On irrigated plots best returns from fertilizer applied were also obtained with the 120-pound nitrogen-12,000 plant stand combination. However, with irrigation the higher rates of nitrogen and thicker stands were utilized quite effectively.

This experiment will be repeated. In seasons with less favorable distribution of rainfall than 1950 the advantage for supplemental irrigation may be much greater. These results suggest that supplemental irrigation, when feasible, will remove still another limitation to efficient land use in the production of corn.

Summary

Fertilizer and soil-management practices for corn have changed greatly since World War II. The newer methods have evolved from research conducted over five years in the major soil areas of the State. The results of a series of field experiments in the hill section are summarized, and recommended practices are outlined.

The research has shown the importance of balancing fertilizer rate and plant stand. Nitrogen at 100 to 120 pounds per acre in combination with stands of 10,000 or 12,000 plants per acre gave excellent results. Phosphoric acid and potash are essential with these intensive practices on most soils of the hill section.

Winter legumes may be grown to supply a part of the needed nitrogen. Perennial, deep-rooted legumes which loosen and deepen the soil have values in addition to the nitrogen and organic matter they supply.

These high-fertility methods of growing corn have several incidental advantages. The dense vegetative canopy discourages growth of grass and weeds, the fertilized corn has higher protein content, and crop residues returned to the soil are increased to about three fold.

A cost study revealed that the high-fertility practices are highly profitable.

Preliminary studies indicate that even more intensive cropping may be practical if the dry-weather hazard is eliminated by means of supplemental irrigation.

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[4] This experiment was conducted in cooperation with F. E. Edwards, E. A. Kimbrough, and Ralph Dickerson of the Department of Agricultural Engineering.

Appendix table 1. Yields of corn from several nitrogen-stand combinations in experiments conducted from 1946 to 1950 inclusive.

Experiment	Soil Type	Nitrogen: 0	30	60	90	120	150
		Plants: 4,000	4,000	8,000	12,000	12,000	16,000
		1946					
North Mississippi Branch Station	Grenada silt loam	17.3	30.3	44.8	58.6	59.9	
North Mississippi Branch Station	Grenada silt loam	(17.8)*		(58.4)*	(74.0)*		
F. L. Honnoll farm, Caledonia	Tilden f. s. l.	21.0		52.2**		81.8	
West Point Branch Station	Houston clay	14.9	14.6	25.1	29.2	35.5	
J. C. Ferguson farm, Hickory	Prentiss f. s. l.	15.7	27.4	48.0	68.3	78.7	
Natchez Branch Station	Memphis silt loam	23.6	31.6	53.1	65.8	63.0	
South Mississippi Branch Station	Ruston sandy loam	(22.5)	(38.5)		(55.7)*		
Mean for 1946		19		45		64	
		1947					
North Mississippi Branch Station	Grenada silt loam	14.0	20.0	28.5	34.0	38.9	
North Mississippi Branch Station	Grenada silt loam	(10.9)*		(36.4)*	(52.8)*		
Main Station, State College	Kaufman f. s. l.	31.4		58.1**		96.2	
J. C. Ferguson farm, Hickory	Prentiss f. s. l.	11.4	20.8	40.1	40.1	43.7	
Mean for 1947		19		42		60	
		1948					
North Mississippi Branch Station	Grenada silt loam	19.8	34.0	61.9	72.3	95.8	
North Mississippi Branch Station	Grenada silt loam	(11.8)*		(42.2)*	(68.1)*		
Main Station, State College	Kaufman f. s. l.	29.3		74.5**		103.4	
Coastal Plain Branch Station	Prentiss f. s. l.	12.5		29.3**		27.4	
Mean for 1948		21		55		76	
		1949					
North Mississippi Branch Station	Grenada silt loam	15.9	28.4	36.6	43.4	50.8	
North Mississippi Branch Station	Grenada silt loam	(3.3)*		(39.3)*	(52.8)*		
Main Station, State College	Kaufman f. s. l.	21.2		67.9**		100.4	
Black Belt Branch Station	Houston clay	33.0		56.8	68.1	73.0	77.7
Coastal Plain Branch Station	Prentiss f. s. l.	7.4		38.3	53.1	52.4	64.8
Brown Loam Branch Station	Grenada silt loam	13.4		43.6	51.9	66.6	78.1
South Mississippi Branch Station	Ruston sandy loam	15.8		50.6	69.0	81.7	
Mean for 1949		18		49		71	
		1950					
North Mississippi Branch Station	Grenada silt loam	14.2	29.9	48.6	59.3	64.8	
Main Station, State College	Kaufman f. s. l.	35.8		79.6**		121.8	
State College	Houlka f. s. l.	39.2		74.8		105.1	
Black Belt Branch Station	Houston clay	48.9		65.4		83.4	86.5
Brown Loam Branch Station	Grenada silt loam	40.1		61.9		80.0	79.2
Coastal Plain Branch Station	Prentiss f. s. l.	9.2		45.0		57.8	57.8
South Mississippi Branch Station	Ruston sandy loam	26.7		53.0		69.3	
Mean for 1950		31		61		83	
Mean 1946-1950 inclusive		22		52		**72**	

( )Not included in means, all treatments not represented.

*8,000 plants per acre.

BULLETIN 487 JANUARY 1952

Corn Hybrids And Varieties

1951 Tests In Mississippi

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
CLAY LYLE, Director

STATE COLLEGE MISSISSIPPI

These corn tests are a cooperative project between the Mississippi Experiment Station and the Division of Cereal Crops and Diseases, Bureau of Plant Industry, Soils and Agricultural Engineering, and the Division of Cereal and Forage Insect Investigations, Bureau of Entomology and Plant Quarantine, Agricultural Research Administration, U. S. Department of Agriculture.

Project leader, Robert C. Eckhardt, agronomist, B. P. I. S. and A. E. and Mississippi Experiment Station, State College, Mississippi.

Donald H. Bowman, agronomist, Delta Branch Station, Stoneville.
H. D. Bunch, assistant agronomist, Experiment Station, State College.
W. A. Douglas, entomologist, Bureau of Entomology and Plant Quarantine, State College.
S. P. Crockett, superintendent, North Mississippi Branch Station, Holly Springs.
Robert Albritton, superintendent, Northeast Mississippi Branch Experiment Station, Verona.
Louie Walton, superintendent, Black Belt Branch Station, Brooksville.
R. E. Coats, agronomist, Brown Loam Branch Station, Oakley.
K. C. Freeman, agronomist, Coastal Plain Branch Station, Newton.
T. E. Ashley, superintendent, South Mississippi Branch Station, Poplarville.

Two plantation trials included in these tests were made possible through the cooperation of E. T. Shaffer, Yazoo City and King and Anderson Plantation, Clarksdale.

Corn Hybrids And Varieties --- 1951

Three Dixie hybrids were top yielders in 1951 corn performance tests conducted by the Mississippi Agricultural Experiment Station. Dixie 33, 17, and 11, in that order, led when data from all tests, except South Mississippi, were averaged. The next three highest yielders in this average included Funk G785W, Funk G-714A and Pfister (PAG) 631.

At Poplarville, where tests for South Mississippi are conducted, Dixie 18 led the field of regular entries, although it was exceeded in yield by an experimental hybrid of which seed are not available for distribution.

These tests, designed to measure the performance of corn hybrids and varieties, were planted at State College, the seven branch stations and two farms in the Delta. The tests at Yazoo City and Brooksville were not harvested, consequently the results reported include the remaining eight experiments.

As farmers become more experienced in the use of corn hybrids they learn that all hybrids do not perform equally well. At the present time a few farmers are dissatisfied with corn hybrids because when purchasing the seed they did not specify a particular hybrid. Although there are a number of adapted hybrids better than the best adapted varieties, the Experiment Station has always recommended the use of a good adapted open-pollinated variety in preference to a poor unadapted hybrid which not only gives low yield but often has poor quality grain, and practically no insect resistance.

Explanation of Tables

Each test contained sixteen entries arranged in a balanced lattice design with five replications. Each plot was two rows wide and ten hills long with rows and hills 40 inches apart (42 inches at Poplarville). Five seeds were planted per hill and later thinned to two or three plants per hill. Tests at Holly Springs, Newton, Oakley and Poplarville were thinned to two plants per hill which with a perfect stand resulted in about 8,000 plants per acre. Three plants per hill, or approximately 12,000 plants per acre, were left in the tests at Verona, State College, Stoneville, and Clarksdale. Subterranean cutworms further reduced the stand at Stoneville.

Lengthy drought periods in the early and latter part of the growing season seriously affected the yields of a majority of the tests. Late maturing hybrids were more adversely affected than the earlier hybrids. The lack of moisture preceding harvest is reflected in the generally low percentage of unsound ears.

Yields at Poplarville and Clarksdale are based on 70 pounds of field dry ear corn per bushel. Moisture samples were taken at all other locations where yields are based on actual weight of the shelled grain adjusted to 15.5% moisture. Three-year averages are more reliable than yield data from one year and should be carefully considered when choosing a hybrid.

The percentage of plants lodged is based on actual counts. All plants broken below the top ear-bearing node (joint) were classified as stalk lodged while all plants leaning 30 degrees or more were root lodged. At State College both and stalk lodging were each divided into two classifications depending upon whether the plants were lodged to the extent that the ears touched the ground.

Ears infested with rice weevil and corn earworms are shown in percent. Rice weevil damage was so slight that a measure of resistance could be obtained only at Poplarville. Data on earworm infestation are reported from four locations. Ear height is reported as the distance in feet from the ground to the point where the top ear is attached to the plant. Ears per plant indicate whether the hybrid is one-eared or prolific; it is obtained by dividing the number of ears harvested by the total number of plants. Husk length is reported in the number of inches that the husk extends beyond the tip of the ear.

The shelling percentage is a measure of the ratio of grain to cob in a sample of ear corn. A shelling percentage of 85 means that in 100 pounds of ear corn, 85 pounds are grain and 15 pounds are cobs. Generally speaking prolific hybrids have more grain and less cob than do one-eared hybrids. The commonly used formula, 70 pounds of ear corn equal one bushel, is based upon dry corn having a shelling percentage of 80. When a farmer sells corn with a shelling percentage of 84 according to this formula, he is giving away 4 pounds of grain in every 100 pounds of ear corn.

Statewide Results

Fifteen of the sixteen hybrids and varieties were planted at all locations except Poplarville. The seven-station averages are reported in Table 1. Dixie 33, Dixie 17 and Dixie 11 were the three highest yielding hybrids with Funk G785W, Funk G714A, Pfister (PAG) 631 and Dixie 22 completing the list of those yielding in the top one-half of the test. It is important to note that the same Dixie hybrids were the highest yielding entries at six locations for the period 1949 through 1951. This shows that under a set of 18 different environmental conditions these hybrids have been consistently high yielding.

Dixie 17 is a white prolific hybrid that is high yielding in all parts of the state. However, since it has but fair husk coverage it is adapted as a full season corn only in the northern one-third of Mississippi. It is suitable in the remainder of the state for hogging-off or early harvest. In 1951, Dixie 17 stalk-lodged more than other hybrids. Dixie 33 is similar to Dixie 17 and is adapted to the same area. It is more resistant to lodging than Dixie 17 but is more susceptible to ear rots. The kernels of both Dixie 17 and Dixie 33 have a reddish-copper tinge.

Dixie 11 is a high yielding prolific hybrid having pure white grain of excellent quality and high shelling percentage. The husk is longer and tighter than either Dixie 17 or Dixie 33 thus giving Dixie 11 better protection against the rice weevil. For this reason, Dixie 11 is better adapted to the central section of the state. Although it lodges badly under many conditions, it is the only high-yielding white corn available for this area.

Dixie 22 is a semi-prolific yellow hybrid with medium large ears, some of which are nearly red. The performance of Dixie 22 over a long period of time has proven it to be the highest yielding yellow hybrid tested. Because of loose husks it should be used only in the upper one-third of the state for a full season corn.

Dixie 82, a yellow hybrid similar to Dixie 22, was planted at State College and Newton. It outyielded Dixie 22 at both locations although the difference in yields was not statistically significant. Dixie 82 lodged slightly more and had a lower shelling percentage than Dixie 22.

Dixie 18 is a yellow hybrid with excellent quality grain. It is one of the few commercial hybrids possessing superior resistance to lodging. Dixie 18 has a long tight husk which makes it particularly desirable for use in the southern and central sections of the state where protection against the rice weevil is necessary. It also seems to be somewhat resistant to serious attacks of corn earworms. Under certain conditions the ears are high but no higher than Station Mosby. The yields of this late maturing hybrid were seriously affected by the extremely dry period in the late summer.

Funk G785W is a prolific white hybrid with good quality grain. It was entered for the first time in 1951 and on the basis of one year's trial appears to be a good hybird. It ranked fourth in the average of the seven tests. It had more plants erect at the time of harvest than Dixie 11, Dixie 17 and other Funk hybrids tested, but did not stand as well as Dixie 33 and Dixie 18. Funk G714A is a yellow hybrid with grain of good quality. It ranked fifth highest in the average yield of all tests. This hybrid lodged badly, the stalk breakage exceeded only by Funk G780W and Dixie 17. Funk G714A has been tested two years. An average of the two-year data shows that Funk G714A yielded less and stalk lodged considerably more than the yellow hybrids Dixie 18 and Dixie 22. Funk G780W is a white hybrid with excellent quality grain. It lodged almost as much as Dixie 11 and Dixie 17 but had more stalk breakage than Dixie 11. In the 1949-51 average of six locations Funk G780W outyielded Station Mosby by about 5 percent but yielded 8 percent less than Dixie 11. In 1951, Funk G780W yielded proportionately better in the Delta than it did in the hill tests.

Pfister (PAG) 631 ranked sixth in the average of all stations in 1951. This white hybrid is chiefly one-eared and has enough husk coverage for adaptation to North Mississippi only. It did not lodge as much as Dixie 17 but lodged more than Dixie 33 and approximately the same as Dixie 22. An average of six stations over a period of 3 years shows Pfister (PAG) 631 to be about equal in yield to Funk G780W but it has consistently stood better than this Funk hybrid. Pfister (PAG) 620 was tested for the first time and although it stood somewhat better than Pfister (PAG) 631 it appeared to be no better in other respects. These hybrids are several days earlier than other hybrids in the test. About 10 percent of the ears of both Pfister (PAG) 631 and Pfister (PAG) 620 had rotten butts. Both also yielded near the top of the test at State College and at the bottom at Stoneville. In both instances the yields were near 100 bushels per acre indicating that this is probably the maximum yield of these one-eared hybrids for the particular plant population. Where skips in the normal stand occur, such as at Stoneville, the yields of one-eared hybrids are reduced to a greater extent than are the yields of the prolifics.

Coker 811 is a prolific hybrid with small ears of hard white grain and high quality. It was not outstanding in all tests from the standpoint of yield. It has excellent resistance to lodging, excelling even Dixie 18 in the 1951 tests. In experiments where lack of moisture was a major limitation the yields of this hybrid were low.

Experimental hybrid Miss. 1206 was below the half-way mark in the average of all tests but was among the high entries in lodging resistance. Miss. 1206 and Miss. 1210 (at Newton) showed a decided resistance to earworm infestation. Both of these hybrids are yellow.

Results at Poplarville

Dixie 18 was superior to other commercial hybrids in yield, resistance to lodging, resistance to rice weevil and in resistance to earworm. Coker 811 was high yielding and was highly resistant to lodging but had considerable damage from insects. Georgia 281 is a white hybrid. It yielded considerably less than Dixie 18 and Coker 811 but was equal to Dixie 18 in resistance to rice weevil and earworm and superior to Coker 811 in these respects. It lodges more than Dixie 18 and has a high ear attachment.

Miss. 0101 (white) was the highest yielding entry in the test despite the large amount of weevil damage. Dixie 17, Dixie 33 and Dixie 22 do not have sufficient husk coverage for use in South Mississippi except for early harvest or hogging-off.

Miss. 1202 (yellow) yielded reasonably well, had little lodging and was fairly resistant to rice weevil. Station Mosby yielded about midway in the test but was among those which lodged rather badly. La. 521 (white) yielded slightly more than Georgia 281 but lodged more than any entry in the experiment; the weevil resistance was fair. Miss. 0202 (yellow) was among the lower yielding hybrids but was superior in standability and resistance to rice weevil. Funk G791W (white) and Funk G737 (yellow) were low yielding and stalk lodged but gave above average resistance to attacks of rice weevil. Miss. 1204 (yellow) showed resistance to lodging but was low yielding.

The results of the individual tests are given in Table 2 through 9. The characteristics of the various hybrids can be obtained from an average (Table 1) of the seven tests but individual tables of the various locations show the effects of local environment. While studying the data, the reader should remember that the yield data from a three-year average is more reliable as a measure of the performance of a hybrid than the results of only one year.

Hybrid Recommendations

North Mississippi (North of U. S. Highway 82)

Dixie 17 (white)
Dixie 33 (white)
Dixie 22 (yellow)
Pfister (PAG) 631 (white)
Dixie 11 (white) southern counties
Dixie 18 (yellow) southern counties for cribbing

Central Mississippi (North of U. S. Highway 80 and South of U. S. 82)

Dixie 18 (yellow)
Dixie 11 (white)
Dixie 17 (white) early feed or hogging off only
Dixie 33 (white) early feed or hogging off only
Dixie 22 (yellow) early feed or hogging off only
Pfister (PAG) 631 (white) early feed or hogging off only

Southern Mississippi (South of U. S. Highway 80)

Dixie 18 (yellow)
Dixie 11 (white) northern counties
Georgia 281 (white) southern counties
Dixie 17 (white) early feed or hogging off only
Dixie 33 (white) early feed or hogging off only
Dixie 22 (yellow) early feed or hogging off only
Pfister (PAG) 631 (white) early feed or hogging off only

Table 1. Average of seven hybrid corn tsts in 1951 (omitting Poplarville.)

Pedigree	Acre yield	Average yield[4] 1949-51	Plants erect at harvest	Lodging		Un-sound ears[1]	Ears infested Earworm[2]	Ear ht.	Ears per plant	Husk[3] length	Shell-ing[4]	Stand
				Root	Stalk							
	bu.	bu.	%	%	%	%	%	ft.	no.	in.	%	%
Dixie 33	76.8	77.9	74	9	17	4	88	4.6	1.3	2.3	84.6	93
Dixie 17	72.0	78.8	50	9	41	3	85	4.4	1.5	2.3	84.8	91
Dixie 11	69.3	74.2	51	19	30	2	85	4.8	1.5	2.9	85.4	94
Funk G785W	68.7	------	69	7	24	2	89	4.8	1.4	2.3	84.6	96
Funk G714A	66.1	------	51	14	35	2	85	4.6	1.5	3.0	82.7	90
Pfister (PAG) 631	65.9	68.2	67	6	27	9	88	3.6	1.1	2.6	81.8	91
Dixie 22	65.0	74.2	61	10	29	3	89	4.4	1.3	2.8	81.2	90
Dixie 18	64.3	------	78	6	16	1	80	5.5	1.3	3.6	83.8	94
Miss. 1206	64.1	------	75	6	19	2	78	4.7	1.3	3.3	80.6	95
Pfister (PAG) 620	63.5	------	72	4	24	10	91	3.8	1.0	1.6	83.2	89
Miss. 1204	63.3	------	74	9	17	3	84	4.5	1.2	3.1	78.8	93
Funk G780W	63.2	68.4	56	7	37	4	84	5.0	1.4	2.3	82.7	93
Jellicorse*	61.9	64.9	67	7	26	6	85	4.1	1.3	2.0	82.0	89
Coker 811	59.9	------	86	6	8	1	85	4.3	1.3	2.3	81.4	92
Station Mosby*	58.1	65.2	57	14	29	4	89	5.4	1.1	2.4	82.5	86

*Open pollinated varieties.

[1] Two-station average.

[2] Three-station average.

[3] Five-station average.

[4] Six-station average.

Table 2. Hybrid corn test at Poplarville, 1951.

Pedigree	Acre yield	Average yield 1949-51	Plants erect at harvest	Lodging		Ears Infested		Ear ht.	Ears per plant	Husk length	Stand
				Root	Stalk	Rice Weevil	Ear-worm				
	bu.	bu.	%	%	%	%	%	ft.	no.	in.	%
Miss. 0101	61.2	------	95	1	4	53	80	3.0	1.0	2.2	98
Dixie 18	60.7	62.6	98	0	2	20	64	2.9	1.5	3.4	98
Coker 811	58.1	------	97	0	3	35	71	2.0	1.5	1.8	100
Dixie 82	55.1	------	97	0	3	56	89	2.5	1.3	2.2	98
Dixie 11	53.9	59.7	73	3	24	36	68	2.9	1.6	2.0	94
Dixie 17	52.2	57.9	82	4	14	80	96	2.1	1.6	1.8	96
Miss. 1202	51.0	------	95	0	5	30	79	2.5	1.1	2.8	98
Dixie 33	49.6	------	94	1	5	90	99	2.0	1.3	1.2	98
Station Mosby*	49.6	50.8	79	6	15	65	91	3.1	1.2	2.4	94
La. 521	49.4	------	63	10	27	30	75	3.2	1.4	2.0	93
Georgia 281	48.6	57.0	80	6	14	20	66	3.5	1.5	3.6	96
Miss. 0202	47.5	------	97	0	3	23	71	2.2	1.4	2.8	96
Dixie 22	45.6	------	82	2	16	74	91	2.2	1.2	2.0	98
Funk G791W	45.5	------	80	0	20	30	69	3.1	1.1	2.4	96
Miss. 1204	45.5	------	95	0	5	64	90	2.0	1.0	2.8	96
Funk G737	40.7	------	76	4	20	34	74	2.2	1.1	2.6	94

A difference in yield of 6.1 bushels per acre is required to be considered significant.

*Open pollinated variety.

Table 3. Hybrid corn test at Holly Springs, 1951.

Pedigree	Acre yield	Average yield 1949-51	Plants erect at harvest	Lodging		Ear ht.	Ears per plant	Shelling	Stand
				Root	Stalk				
	bu.	bu.	%	%	%	ft.	no.	%	%
Dixie 33	46.3	61.0	89	1	10	4.6	1.2	84.1	98
Pfister (PAG) 631	40.9	54.0	81	1	18	3.8	1.0	81.1	96
Dixie 17	38.4	57.0	50	1	49	4.3	1.3	83.2	91
Pfister (PAG) 620	36.2	——	78	1	21	3.9	1.0	81.1	84
Funk G714A	34.4	——	52	0	48	4.5	1.2	80.9	100
Miss. 1204	32.8	——	83	1	16	4.3	1.0	78.5	94
Dixie 22	32.0	55.7	65	1	34	4.5	1.0	80.3	87
Jellicorse*	31.8	47.2	74	0	26	4.1	1.1	80.8	90
Miss. 1210	31.6	——	70	0	30	4.8	1.1	79.1	90
Miss. 1206	31.5	——	82	0	18	4.7	1.0	80.6	91
Funk G785W	30.6	——	69	1	30	5.0	1.1	81.6	100
Dixie 11	29.8	47.6	60	2	38	4.9	1.1	84.2	96
Coker 811	29.0	——	91	1	8	4.5	1.2	79.4	86
Dixie 18	27.2	——	78	0	22	5.7	0.9	82.5	102
Funk G780W	26.3	44.1	56	0	44	5.1	1.0	79.1	98
Station Mosby*	23.9	41.9	60	2	38	5.4	0.8	80.3	88

A difference in yield of at least 3.9 bushels per acre is required to be considered significant.

*Open pollinated varieties.

Table 4. Hybrid corn test at Verona, 1951.

Pedigree	Acre yield	Average yield 1949-51	Plants erect at harvest	Lodging		Ear ht.	Ears per plant	Shelling	Stand
				Root	Stalk				
	bu.	bu.	%	%	%	ft.	no.	%	%
Dixie 33	73.7	82.1	67	18	15	4.3	1.2	85.8	84
Dixie 11	69.5	76.7	27	32	41	4.2	1.4	86.0	89
Dixie 17	67.6	78.0	38	11	51	3.8	1.3	86.4	83
Funk G785W	67.5	-----	59	19	22	4.4	1.2	85.1	90
Pfister (PAG) 631	66.4	68.3	58	19	23	3.5	1.0	83.1	82
Funk G714A	65.9	-----	35	35	30	4.2	1.3	83.5	78
Miss. 1206	63.5	-----	63	18	19	4.4	1.2	80.4	87
Jellicorse*	61.9	63.8	51	17	32	3.8	1.1	83.1	84
Dixie 22	61.4	75.7	39	29	32	4.2	1.1	82.2	85
Miss. 1210	60.8	-----	71	13	16	4.6	1.2	79.2	78
Dixie 18	60.7	-----	66	10	24	5.0	1.3	84.7	83
Pfister (PAG) 620	59.7	-----	72	12	16	3.6	.9	84.0	87
Coker 811	59.2	-----	79	14	7	3.8	1.2	81.8	85
Miss. 1204	58.6	-----	70	17	13	4.2	1.1	79.1	82
Funk G780W	56.2	67.5	40	16	44	4.3	1.2	82.9	78
Station Mosby*	55.4	66.2	45	32	23	4.9	1.0	82.0	84

A difference in yield of at least 5.4 bushels per acre is required to be considered significant.

*Open pollinated varieties.

Table 5. Hybrid corn test at State College, 1951

Pedigree	Acre yield	Average yield 1949-51	Plants erect at harvest	Lodging[1] Root A	Lodging[1] Root B	Lodging[1] Stalk A	Lodging[1] Stalk B	Ears Infested Earworm	Ear ht.	Ears per plant	Husk length	Shell-ing	Stand
	bu.	bu.	%	%	%	%	%	%	%	%	ft.	no.	in.
Dixie 33	104.1	107.9	62	20	1	5	12	86	4.9	1.2	1.8	85.8	98
Pfister (PAG) 620	101.4	-------	73	9	0	4	14	95	4.3	1.0	1.2	84.7	100
Pfister (PAG) 631	93.7	96.8	66	14	0	6	14	92	4.2	1.0	2.0	83.2	99
Dixie 82	91.0	-------	47	16	1	6	30	92	5.1	1.3	2.2	80.7	96
Dixie 17	90.7	107.9	39	23	2	2	34	88	4.8	1.4	2.2	85.9	95
Dixie 11	90.6	106.2	18	42	12	2	26	83	5.3	1.5	2.8	85.5	95
Funk G785W	89.6	-------	63	17	0	4	16	91	4.9	1.3	2.4	85.6	100
Miss. 1204	88.4	-------	50	28	2	2	18	90	4.8	1.0	2.4	79.0	100
Dixie 22	85.7	101.9	47	22	2	3	26	90	5.0	1.1	2.4	81.6	96
Dixie 18	85.1	-------	63	20	1	4	12	75	5.6	1.2	3.2	84.4	101
Jellicorse*	81.3	92.6	55	17	1	4	23	86	4.8	1.2	1.6	83.0	98
Funk G714A	81.3	-------	40	27	3	5	25	89	4.9	1.2	2.6	83.5	100
Funk G780W	78.5	99.9	54	12	2	10	22	83	5.6	1.2	2.0	84.0	103
Miss. 1206	77.8	-------	57	19	0	6	18	81	4.9	1.1	2.6	80.7	101
Station Mosby*	76.0	91.7	46	22	2	8	22	89	5.8	1.1	2.0	85.4	91
Coker 811	67.5	-------	77	16	0	2	5	84	4.6	1.1	1.8	81.5	99

*Open pollinated varieties.

A difference in yield of 7.3 bushels per acre is required to be considered significant.

[1] A—Ears not touching the ground.
B—Ears touching the ground.

Table 6. Hybrid corn test at Newton, 1951

Pedigree	Acre yield	Average yield 1949-51	Plants erect at harvest	Lodging		Ears Infested Earworm	Ear ht.	Ears per plant	Husk length	Shell-ing	Stand[1]
				Root	Stalk						
	bu.	bu.	%	%	%	%	ft.	no.	in.	%	%
Dixie 33	61.6	57.1	95	0	5	82	4.2	1.4	2.4	83.4	104
Dixie 17	61.6	58.9	85	0	15	76	4.0	1.6	2.2	83.3	104
Pfister (PAG) 620	57.4	-----	89	0	11	80	3.2	1.1	2.0	82.5	100
Jellicorse*	57.1	49.2	93	0	7	74	3.8	1.5	2.0	80.8	100
Dixie 82	56.1	-----	88	2	10	78	4.8	1.5	2.4	78.9	102
Funk G785W	56.0	-----	92	0	8	87	4.6	1.6	2.2	83.9	104
Pfister (PAG) 631	56.0	50.3	83	0	17	79	3.0	1.1	2.8	81.4	101
Funk G714A	55.5	-----	88	0	12	77	4.8	1.7	3.4	81.7	102
Dixie 11	55.2	53.9	87	0	13	84	4.8	1.6	2.8	84.2	103
Miss. 1206	54.8	-----	96	0	4	69	4.8	1.5	3.4	80.1	100
Miss. 1210	52.3	-----	93	0	7	66	4.6	1.4	3.8	79.2	102
Miss. 1204	51.8	-----	94	0	6	74	4.0	1.2	3.2	78.2	100
Dixie 22	51.8	52.8	91	0	9	84	4.0	1.3	2.8	80.8	102
Coker 811	51.5	-----	99	0	1	83	4.0	1.5	2.2	80.7	100
Funk G780W	49.6	49.8	87	0	13	76	5.2	1.4	2.4	82.1	102
Station Mosby*	49.4	49.5	91	0	9	85	5.4	1.2	2.6	81.9	99
Dixie 18	49.1	52.2	100	0	0	82	5.6	1.3	3.6	82.7	102

*Open pollinated varieties.

[1] Two plants per hill considered 100 percent stand.

A difference in yield of at least 5.9 bushels per acre is required to be considered significant.

Table 7. Hybrid corn test at Oakley, 1951

Pedigree	Acre yield	Average yield 1949-51	Plants erect at harvest	Lodging		Ears Infested Earworm	Ear ht.	Ears per plant	Husk length	Shell-ing	Stand
				Root	Stalk						
	bu.	bu.	%	%	%	%	ft.	no.	in.	%	%
Dixie 11	65.5	61.2	69	21	10	89	4.8	1.8	2.8	84.4	91
Dixie 17	64.9	64.0	62	11	27	92	4.4	1.8	2.2	83.5	92
Funk G785W	61.2	------	76	6	18	90	5.0	1.7	2.6	84.5	97
Dixie 33	60.5	58.1	80	8	12	96	4.2	1.4	2.6	83.1	94
Miss. 1206	57.8	------	85	2	13	85	4.9	1.6	3.4	80.6	97
Dixie 18	56.6	55.9	92	4	4	83	5.5	1.6	3.2	82.8	88
Funk G780W	55.5	52.6	75	5	20	92	5.2	1.7	2.6	82.4	88
Funk G714A	54.8	------	65	9	26	90	4.2	1.8	3.4	82.3	82
Dixie 22	54.7	58.9	66	5	29	93	4.1	1.5	3.0	79.8	89
Station Mosby*	53.3	51.0	71	13	16	92	5.7	1.4	2.6	82.1	90
Miss. 1204	52.9	------	88	3	9	89	5.1	1.4	3.0	77.9	93
Pfister (PAG) 631	52.4	45.9	69	1	30	94	3.2	1.1	2.8	80.7	88
Miss. 1210	52.3	------	91	1	8	90	4.5	1.5	3.8	79.0	88
Jellicorse*	50.3	49.9	82	6	12	96	3.9	1.5	2.4	80.5	86
Pfister (PAG) 620	49.9	------	73	1	26	97	4.1	1.1	2.2	82.2	81
Coker 811	49.1	------	95	1	4	87	4.1	1.5	2.4	80.8	90

A difference in yield of at least 4.5 bushels per acre is required to be considered significant.

*Open pollinated varieties.

Table 8. Hybrid corn test at Stoneville, 1951

Pedigree	Acre yield	Average yield 1949-51	Plants erect at harvest	Lodging		Unsound eas	Days to 50% silk	Ear ht.	Ears per plant	Husk length	Shelling	Stand
				Root	Stalk							
	bu.	bu.	%	%	%	%	no.	ft.	no.	in.	%	%
Dixie 33	125.5	101.2	67	14	19	5	64	5.1	1.8	2.2	85.7	79
Dixie 18	122.0	------	80	8	12	1	68	6.0	1.7	3.8	85.5	88
Funk G785W	120.9	------	76	4	20	5	66	5.4	1.8	2.0	87.0	90
Dixie 17	120.6	107.1	54	12	34	6	64	4.9	1.9	2.0	86.4	81
Dixie 11	120.3	99.8	56	14	30	4	66	5.2	1.8	3.0	88.1	88
Funk G780W	118.4	96.3	55	11	34	7	67	5.6	1.8	2.2	85.6	83
Dixie 22	117.4	100.3	67	9	24	6	66	4.9	1.7	2.8	82.5	84
Funk G714A	115.3	------	41	21	38	4	66	5.3	1.9	2.8	84.5	81
Miss. 1210	115.1	------	84	1	15	4	66	5.5	1.7	3.8	81.0	92
Coker 811	113.3	------	83	8	9	2	67	5.0	1.7	2.2	84.3	89
Miss. 1206	113.1	------	84	3	13	4	66	5.3	1.7	3.2	81.4	92
Miss. 1204	110.5	------	80	8	12	5	66	5.3	1.5	3.5	80.3	90
Jellicorse*	103.5	86.6	73	4	23	8	64	4.7	1.7	1.8	83.9	74
Station Mosby*	102.5	91.1	61	18	21	7	68	5.6	1.5	2.2	83.5	69
Pfister (PAG) 631	98.9	93.7	84	4	12	11	62	3.8	1.2	3.0	**81.5**	**84**
Pfister (PAG) 620	89.7	------	89	3	8	14	61	3.9	1.1	1.5	84.4	83

A difference in yield of 10.6 bushels per acre is required to be considered significant.

*Open pollinated varieties.

Table 9. Hybrid corn test at Clarksdale, 1951

Pedigree	Acre yield	Plants erect at harvest	Lodging		Unsound ears	Ear ht.	Ears per plant	Husk length	Stand
			Root	Stalk					
	bu.	%	%	%	%	ft.	no.	in.	%
Dixie 33	65.7	56	3	41	3	5.0	1.1	2.3	92
Dixie 17	59.9	27	0	73	0	4.3	1.4	3.0	91
Funk G780W	57.6	25	4	71	2	4.2	1.2	2.3	96
Miss. 1210	56.3	74	1	25	1	4.5	1.0	3.3	92
Funk G714A	55.8	32	5	63	1	4.2	1.3	3.0	86
Funk G785W	55.1	51	2	47	0	4.0	1.0	2.3	93
Dixie 11	54.5	41	9	50	0	4.7	1.2	3.0	93
Pfister (PAG) 631	53.1	34	0	66	8	3.5	1.0	2.3	85
Dixie 22	52.2	49	2	49	1	3.8	1.1	3.0	88
Pfister (PAG) 620	50.3	33	2	66	6	3.5	1.0	1.0	87
Miss. 1206	50.2	58	2	40	0	4.2	1.1	4.0	94
Coker 811	49.6	81	1	18	1	4.2	1.1	2.7	96
Dixie 18	49.2	62	2	36	1	5.3	1.1	4.0	94
Miss. 1204	48.4	57	2	41	2	4.0	0.9	3.3	91
Jellicorse*	47.7	40	3	57	5	3.7	1.0	2.3	90
Station Mosby*	46.0	30	6	64	1	5.2	0.8	2.7	84

*Open pollinated varieties.

A difference in yield of at least 11.3 bushels per acre is required to be considered significant.

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1951 Cotton Variety Tests in Mississippi

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
CLAY LYLE, Director
STATE COLLEGE MISSISSIPPI

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Cotton Variety Tests in the Yazoo-Mississippi Delta, 1951

By JAMES B. DICK and ZANE F. LUND

Three standard cotton variety yield trials were conducted on sandy loam soil in the Delta in 1951 by the Delta Branch Experiment Station in cooperation with Delta farmers. One other test planted on sandy loam and two variety tests planted on "buckshot" soils were abandoned due to poor stands. One variety trial under full mechanization was conducted on Kelso Plantation, but the one at Stoneville could not be used because of uneven emergence due to poor seed and unfavorable weather conditions. Preliminary or partial reports on the three standard tests at Tunica, Money, and Yazoo City are presented in the accompanying tables. Detailed reports on these tests and on the "mechanized" test will be given at a later date.

Due to a late spring, faulty seed from the 1950 crop, and the extremely dry period from April 25 to June 10 in many sections of the Delta the cotton crop was very slow in getting started and much cotton was extremely late, particularly in the middle and upper Delta. Three weeks of rain in late June were followed by a severe drought lasting until mid-September. During this drought the average temperatures were several degrees above normal and cotton on the lighter soils suffered heavily. This was particularly true with late cotton. Early cotton on the better sandy loams and lighter clay soils suffered less and in some areas produced more cotton per acre than in 1950.

Boll weevil infestation throughout the season was generally light, but the damage from heavy infestations of bollworms was the heaviest experienced in many years and required constant watchfulness and control measures.

In spite of the difficulties experienced in 1951 the average yields per acre in the variety trials at Tunica, Money and Yazoo City were considerably above those of 1950. Gin turnouts for the 12 varieties used were slightly lower than for 1950. Staple length was slightly better at Tunica and Money, slightly shorter at Yazoo City. As a whole the 1951 Delta cotton crop was much higher in grade and general quality than the crop of any recent year.

Yield of seed cotton and of lint per acre, gin turnout, staple length, percent earliness, and total money-value-per-acre are given for the three tests. Lint prices used in determining the dollar-per-acre were averages of ten weeks of the Memphis marketing season beginning in early September. Seed were valued at $70 per ton, basis prime.

All varieties in the yield trials were the current improved strains of the reliable breeders or firms whose cottons are commonly grown on a large percentage of the Delta cotton acreage, and are similar to those entered in 1950. The 1951 results are presented as a progress report. As several new varieties and strains entered the yield trials in 1950, no 3-year averages are available. On the other varieties 3-year averages (1947-1949) were previously published in the December 1950 issue of Mississippi Farm Research.

Results of cotton variety yield trial, Yazoo-Mississippi Delta, 1951.

Variety	Yield per acre		Gin turn-out	Staple length	Percent picked first picking	Total money value per acre		
	Seed cotton	Lint				Middling	Strict Low Middling	Low Middling
	Lbs.	Lbs.	Pct.	1/32 in.	Pct.	Dols.	Dols.	Dols.
			TUNICA					
Delfos 9169	2722	953	35.0	35	56	484	465	440
D & P L Fox	2642	934	35.3	34	66	460	443	420
Coker 100 Staple	2583	886	34.4	35	65	453	436	412
Stoneville 2B	2517	898	35.6	34	66	446	430	408
Empire	2524	872	34.6	35	68	447	430	407
Arkot 2-1	2532	844	33.4	35	63	436	419	397
Deltapine 15	2313	884	38.2	35	61	430	413	390
Coker 100 Wilt	2466	845	34.0	35	60	426	410	387
Bobshaw 1-A	2380	839	35.2	34	62	415	401	381
Miller	2318	839	36.3	33	66	409	395	376
Delfos 7343	2199	832	37.8	35	67	406	390	368
Wilds	2026	634	31.3	41	60	405	371	311
Planted April 30, first picking September 11.								
			MONEY					
Delfos 7343	2929	1056	36.0	35	55	522	501	473
Empire	2926	955	32.6	34	52	494	477	454
Coker 100 Wilt	2970	969	32.6	34	51	487	470	443
Miller	2774	964	34.7	32	49	473	457	436
Delfos 9169	2752	901	32.7	35	53	469	451	428
Deltapine 15	2559	969	37.9	34	51	463	447	423
Bobshaw 1-A	2570	893	34.8	34	51	444	428	406
D & P L Fox	2540	893	35.2	34	54	436	420	398
Arkot 2-1	2619	836	31.9	35	53	436	419	397
Stoneville 2B	2458	849	34.4	34	52	422	407	386
Coker 100 Staple	2425	781	32.2	35	54	403	388	367
Wilds	2262	659	29.1	41	44	424	391	329
Planted April 30, first picking September 17.								
			YAZOO CITY					
Coker 100 Wilt	3582	1197	33.6	34	21	604	583	553
Delfos 9169	3422	1157	33.9	34	25	593	573	544
Delfos 7343	3251	1208	37.2	34	25	586	564	535
Arkot 2-1	3391	1139	33.5	34	31	581	561	533
Stoneville 2B	3274	1159	35.5	34	24	576	555	527
Deltapine 15	3017	1193	39.6	34	25	562	541	512
D & P L Fox	3197	1157	36.1	34	27	561	540	512
Empire	3182	1096	34.4	34	28	554	535	508
Coker 100 Staple	3179	1073	33.7	34	23	543	524	498
Bobshaw 1-A	3094	1053	34.0	34	19	532	514	488
Miller	3060	1078	35.2	33	30	531	513	488
Wilds	2646	808	30.5	42	17	516	472	394

Planted April 20, first picking August 24.

Cotton Varieties, Hill Sections, 1951

J. F. O'KELLY, S. P. CROCKETT, K. C. FREEMAN and R. E. COATS

Only a few farm crops vary in yield as a result of weather conditions as much as cotton. Changes in the weather and other environment affect not only the cotton plant but also the insects which attack it. It is difficult to acquire averages covering enough years and varieties to evaluate them correctly.

A look at the averages at each location shows that a farmer in one of these areas can choose one of several varieties and obtain about the same average return. The cotton grower should select a good variety with the characters he likes, as staple length, boll type, lint percentage, earliness, etc., and having done this, should continue to use the variety over a period of several years. Following a policy of this kind makes for stability in the variety picture especially if it can be done on a community-wide scale.

Average results from cotton varieties, State College

	Pounds lint per acre					Averages				
	1947	1948	1949	1950	1951	Lint	Acre value	Staple inches	Lint percentage	Bolls per lb. lint
Deltapine 15	398	743	345	556	523	513	209.56	1 1/16	39.8	185
Miller	480	730	308	465	516	500	200.30	31/32	37.7	172
Coker, staple	458	709	347	436	485	487	205.93	1 3/32	36.6	194
Delfos 7272 (1)	385	700	339	431	518	475	200.07	1 3/32	35.6	204
Bobshaw 1A (2)	423	723	381	396	442	473	192.10	1 1/16	36.7	196
Hi-Bred	439	685	340	336	547	470	176.16	29/32	42.0	147
Coker, wilt	357	707	343	411	509	465	192.54	1 3/32	36.5	185
Delfos 9169	370	694	360	360	477	452	186.78	1 3/32	36.2	183
Empire	364	678	387	307	503	448	181.51	1 1/16	37.2	160
Stoneville 2B	390	727	300	347	455	444	181.38	1 1/16	36.8	179

(1) Delfos 651, 1947-50. (2) Bobshaw 1, 1947-50.

Cotton varieties, State College, 1951

	Pounds lint per acre	Total acre value			Lint percentage	Staple inches	Bolls per lb. lint
		Middling	Strict low middling	Low middling			
Fox	555.9	238.72	228.99	215.37	36.2	1 1/16	201
Hi-Bred	547.5	223.93	215.72	203.13	41.2	15/16	139
Delfos 7343	531.9	226.55	217.24	204.21	37.6	1 1/16	185
Deltapine 15	522.9	221.13	211.98	199.17	38.9	1 1/16	181
Delfos 7272	518.2	225.67	215.56	201.83	35.8	1 3/32	194
Miller	516.2	217.93	209.93	198.06	36.1	31/32	172
Plains	514.5	220.41	211.40	198.80	36.6	1 1/16	170
Coker, wilt	509.0	222.76	212.83	199.35	35.0	1 3/32	179
Empire	503.2	217.29	208.49	196.16	35.3	1 1/16	158
Coker, staple	485.0	218.28	208.58	191.12	34.5	1 1/8	195
Hybrid 56	480.8	210.69	201.31	188.57	34.8	1 3/32	184
Delfos 9169	477.1	209.20	199.90	187.26	34.7	1 3/32	175
Stoneville 2B	455.0	192.98	185.24	174.78	36.9	1 1/32	160
Stoneville 2492	449.4	194.30	186.44	175.43	35.1	1 1/16	166
Arkot 2-1	447.3	197.03	188.31	176.46	34.0	1 3/32	177
Bobshaw 1A	441.9	188.56	181.04	170.88	35.9	1 1/32	195

Two new varieties, Fox and Arkot 2-1, have not been in the tests long enough to appear in the averages. They are a little earlier than many of the other varieties and should be considered where earliness is important.

Where trouble from fusarium wilt is mild it may be well to fertilize liberally and use one of the varieties now generally grown which may have only slight tolerance to the disease. If, however, trouble from this disease is usually severe it may be well to use one of the more resistant varieties. Among the best of these are Plains, Coker wilt, and Empire. It is not possible to make definite statements concerning Verticillium wilt at this time.

All of the 1951 tests were well fertilized before planting with a complete fertilizer. Insect control was adequate and

Average results from cotton varieties, Newton

	Pounds lint per acre				Averages				
	1948	1949	1950	1951	Lint	Acre Value	Staple inches	Lint percentage	Bolls per lb. lint
Bobshaw 1A (1)	471.9	245.1	555.7	452.2	431.2	180.02	1 1/32	37.6	223
Stoneville 2B	498.8	267.3	518.3	410.9	423.8	177.90	1 1/16	38.0	201
Hi-Bred	515.4	273.6	420.3	466.5	418.9	155.38	7/8	42.7	175
Coker, wilt	489.8	258.0	510.2	401.0	414.7	172.34	1 1/32	37.6	218
Empire	459.4	283.2	576.6	336.2	413.8	171.79	1 1/32	38.9	186
Deltapine 15	459.7	308.2	528.9	330.9	406.9	165.87	1 1/32	41.0	217
Miller	501.6	194.1	495.5	412.5	400.9	164.64	31/32	38.2	205
Delfos 9169	450.8	232.7	479.3	367.4	382.5	161.56	1 1/16	37.5	202
Coker, staple	450.4	180.6	463.9	372.0	366.7	156.27	1 1/16	37.2	235
Delfos 7272 (2)	432.8	223.1	413.9	334.9	351.2	146.52	1 1/16	36.9	234

(1) Bobshaw 1, 1948 and 1949. (2) Delfos 651, 1948, 1949 and 1950.

Cotton varieties, Newton, 1951

	Pounds lint per acre	Acre value seed and lint			Lint percentage	Staple inches	Bolls per lb. lint
		Middling	Strict low middling	Low middling			
Hi-Bred	466.5	184.25	182.15	171.42	42.0	27/32	216
Bobshaw 1A	452.2	188.89	181.88	171.48	37.9	31/32	263
Hybrid 56	414.6	176.48	169.44	159.90	36.3	1 1/32	249
Miller	412.5	172.29	166.10	156.61	37.3	15/16	242
Stoneville 2B	410.9	172.46	165.68	156.43	37.9	1	235
Coker, wilt	401.0	168.78	162.17	153.14	37.4	1	255
Delfos 7343	376.6	157.12	150.71	142.05	39.9	1 1/32	259
Coker, staple	372.0	158.63	152.31	143.75	36.0	1 1/32	295
Delfos 9169	367.4	155.46	149.21	140.76	37.3	1 1/32	207
Arkot 2-1	360.8	153.77	147.64	139.34	36.1	1 1/32	234
Stoneville 2492	351.0	148.16	142.37	134.47	36.9	1	223
Fox	341.2	143.54	137.91	130.23	37.5	1	290
Empire	336.2	140.49	134.94	127.37	38.7	1	212
Delfos 7272	334.9	140.96	135.44	127.90	37.4	1	285
Deltapine 15	330.9	136.60	131.47	123.86	40.1	31/32	252
Plains	317.8	134.00	128.76	121.60	37.1	1	272

especially thorough at Newton. The tests were handicapped by too little rain in the early part of the season and again at the critical stage of fruiting. For a short period early in July the Oakley test suffered from too much rain.

If low soil moisture and high temperature cause the cotton plants to wilt a great deal in mid-day flower buds and young bolls will be shed in proportion to the severity of the wilting. This contributed much to the low yields in these tests in 1951. The very small boll sizes at Newton and Oakley are due to this in part.

The acre values were computed in the usual way. The lint prices were averages of ten weeks of the Memphis marketing season beginning in late August. Seed was valued at $68.00 a ton. Values were computed for three grades in order to show how the value is reduced by deterioration due to weather and other damage.

Average results from cotton varieties, Holly Springs

	Pounds lint per acre					Averages				
	1947	1948	1948	1950	1951	Lint	Acre value	Staple inches	Lint percentage	Bolls per lb. lint
Delfos 9169	639	732	563	568	456	591	243.34	1 1/16	37.0	188
Coker, staple	621	731	547	566	374	568	232.17	1 1/16	37.4	204
Stoneville 2B	665	756	457	518	430	565	229.93	1 1/32	37.4	181
Coker, wilt	623	703	514	573	406	564	230.00	1 1/32	37.6	191
Miller	673	742	498	484	408	561	220.07	31/32	38.4	181
Hi-Bred	667	746	528	426	411	556	206.17	7/8	42.4	157
Empire	620	708	565	502	381	555	222.82	1 1/32	38.4	168
Deltapine 15	608	690	551	526	399	555	220.00	1 1/32	40.5	197
Delfos 7272 (1)	640	675	496	478	437	545	223.92	1 1/16	36.4	209
Bobshaw 1A (2)	624	657	447	534	424	537	217.62	1	37.2	205

(1) Delfos 651, 1947-50. (2) Bobshaw 1, 1947-49.

Cotton varieties, Holly Springs, 1951

	Pounds lint per acre	Acre value seed and lint			Lint percentage	Staple inches	Bolls per lb. lint
		Middling	Strict low middling	Low middling			
Fox	474.3	197.90	190.54	179.64	38.1	31/32	237
Delfos 9169	455.7	192.51	184.76	174.28	37.6	1 1/32	201
Delfos 7272	436.9	183.16	175.95	166.12	38.1	1	223
Delfos 7343	436.0	180.94	173.75	163.94	40.0	1	206
Stoneville 2B	430.5	179.79	172.69	163.00	38.8	1	186
Arkot 2-1	429.3	182.22	175.13	165.47	36.0	1	200
Bobshaw 1A	423.8	176.69	170.33	160.59	37.6	15/16	219
Hybrid 56	415.2	174.65	168.22	158.67	36.7	31/32	219
Stoneville 2492	413.0	173.42	167.01	157.52	37.0	31/32	196
Hi-Bred	410.6	161.25	159.40	149.96	43.2	27/32	161
Miller	407.6	166.49	163.03	153.65	38.0	29/32	188
Coker, wilt	406.0	171.19	164.49	155.36	37.1	1	192
Plains	404.3	167.80	161.74	152.44	38.4	15/16	198
Deltapine 15	399.3	164.33	158.14	148.95	40.7	31/32	203
Empire	381.3	159.33	153.04	144.46	38.7	1	169
Coker, staple	373.6	158.65	152.30	143.70	36.7	1 1/32	219

Average results from cotton varieties, Oakley

	Pounds lint per acre			Averages				
	1948	1949	1951	Lint	Acre value	Staple inches	Lint percentage	Bolls per lb. lint
Empire	225.4	380.4	408.2	338.0	130.06	1 1/32	37.9	189
Hi-Bred	262.7	301.7	423.8	329.4	115.33	27/32	42.1	182
Miller	249.6	344.2	368.1	320.6	121.52	31/32	37.6	210
Deltapine 15	271.3	358.8	320.0	316.7	119.08	1	39.5	214
Stoneville 2B	240.5	286.8	388.9	305.4	119.44	1 1/32	36.3	220
Delfos 9169	230.8	257.2	414.7	300.9	119.69	1 1/16	36.0	210
Delfos 7272 (1)	229.7	322.4	325.2	292.4	113.85	1 1/16	35.8	235
Coker, staple	222.3	338.5	315.8	292.2	114.19	1 1/16	35.7	236
Bobshaw 1A (2)	217.2	265.0	382.5	288.2	113.10	1 1/32	35.8	228
Coker, wilt	227.2	300.1	334.4	287.2	111.80	1 1/32	36.5	223

(1) Delfos 651, 1948 and 1949.

(2) Bobshaw 1, 1948 and 1949.

Cotton varieties, Oakley, 1951

	Pounds lint per acre	Acre value seed and lint			Lint percentage	Staple inches	Bolls per lb lint
		Middling	Strict low middling	Low middling			
Hi-Bred	423.8	170.02	168.12	158.37	39.0	27/32	209
Delfos 9169	414.7	180.84	173.58	163.42	33.8	1 1/16	250
Empire	408.2	175.18	168.24	158.85	35.0	1 1/32	219
Stoneville 2492	407.9	174.93	168.20	159.02	34.4	1	244
Stoneville 2B	388.9	167.34	160.92	152.17	33.9	1	269
Arkot 2-1	385.3	170.08	163.34	153.90	32.1	1 1/16	269
Bobshaw 1A	382.5	164.81	158.50	149.89	33.7	1	295
Miller	368.1	157.21	151.69	143.22	33.8	15/16	255
Plains	357.4	153.38	147.30	139.08	35.0	1 1/32	274
Fox	357.1	154.27	148.20	139.98	34.0	1 1/32	314
Delfos 7343	346.1	149.21	143.33	135.37	34.3	1 1/32	320
Hybrid 56	337.0	146.60	140.87	133.12	33.0	1 1/32	270
Coker, wilt	334.4	145.93	140.08	131.89	33.7	1 1/16	262
Delfos 7272	325.2	140.78	135.09	127.12	34.9	1 1/16	289
Deltapine 15	320.0	135.66	130.38	123.18	36.2	1	281
Coker, staple	315.8	139.19	133.66	125.92	32.3	1 1/16	308

BULLETIN 489 MARCH 1952

Bolivar County Soils

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
CLAY LYLE, Director

STATE COLLEGE MISSISSIPPI

SURVEY PARTY FOR BOLIVAR COUNTY

Soil survey made by C. G. Morgan, formerly in charge of Delta soil survey program, G. E. Rogers, party chief, W. E. Keenan, J. C. Powell, E. J. McNutt, K. R. Harris, Mississippi Agricultural Experiment Station and D. A. Yost and A. B. Maxwell, Bureau of Plant Industry, Soils and Agricultural Engineering.

The Soil Conservation Service and the Bureau of Plant Industry, Soils and Agricultural Engineering cooperated with the Mississippi Agricultural Experiment Station in the Soil Survey of Bolivar County.

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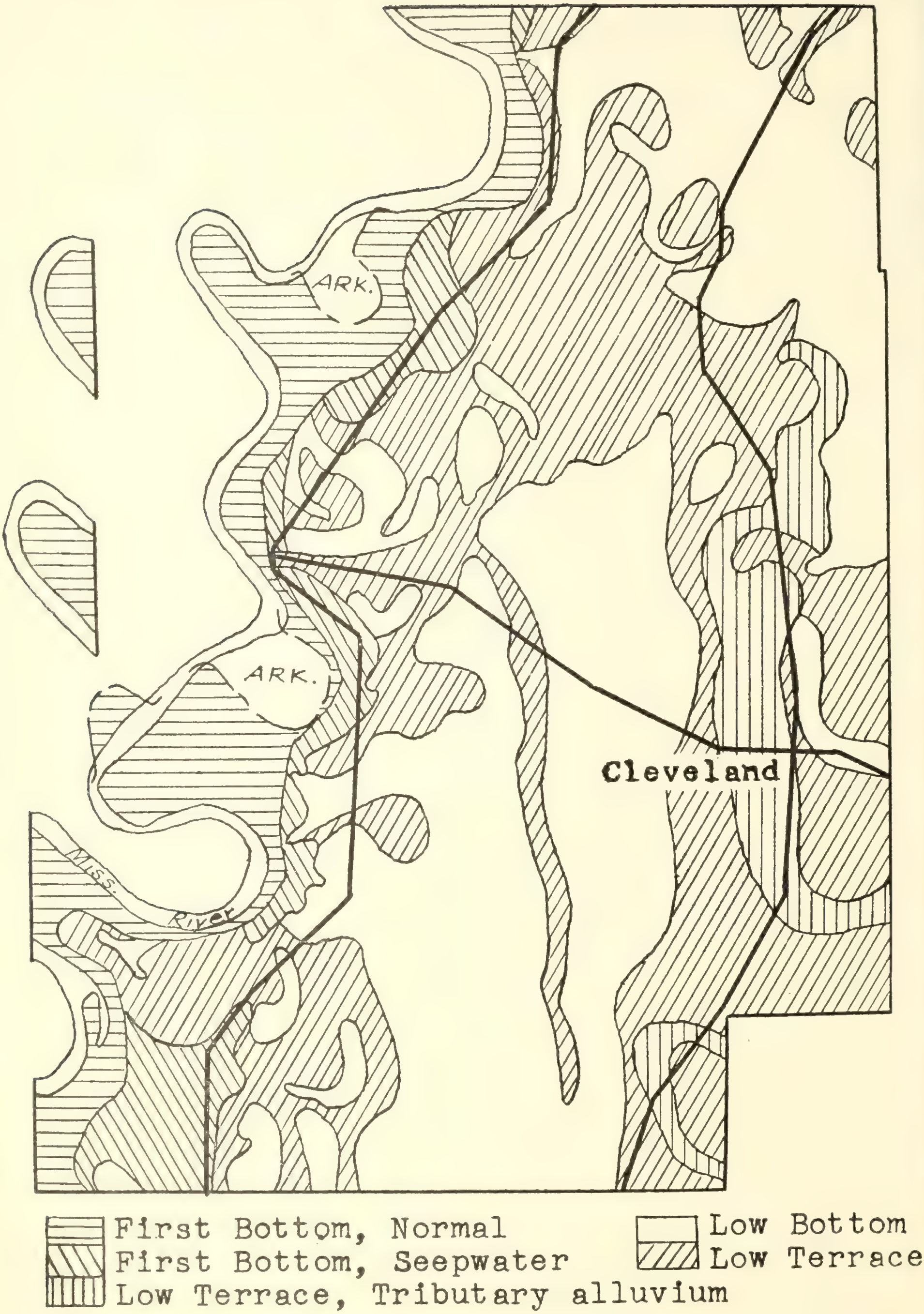

ARK.
ARK.
Miss. River
Cleveland
First Bottom, Normal
First Bottom, Seepwater
Low Terrace, Tributary alluvium
Low Bottom
Low Terrace

Fig. 1. Major soil groups of Bolivar County.

Bolivar County Soils

By G. E. ROGERS and H. B. VANDERFORD

This bulletin is written primarily for the farmers of Bolivar County. It has been prepared to aid them in their study and use of the soil maps of this county.

The recommendations for management and land use are based on field experiments of the Mississippi Agricultural Experiment Station, observation and field studies, and the experience of good farmers. Suggestions, based on good soil conditions, in relation to secondary drainage, field arrangement, row direction, crop adaptability and treatments for each type soil have been included.

In using this bulletin with a soil map in Bolivar County, follow the instructions listed below for easy reference:

1. Locate the boundary of your farm on the soil map.
2. Note soil numbers on your soil map. Determine the class of your land by reading the legend on the map.
3. Turn to the index of the bulletin to determine the page where the use and management of the soil class is discussed.
4. For further information, turn to the table of contents.

How To Know Your Soils And Plan Their Management

FIRST EXAMINE THE SOIL MAP.

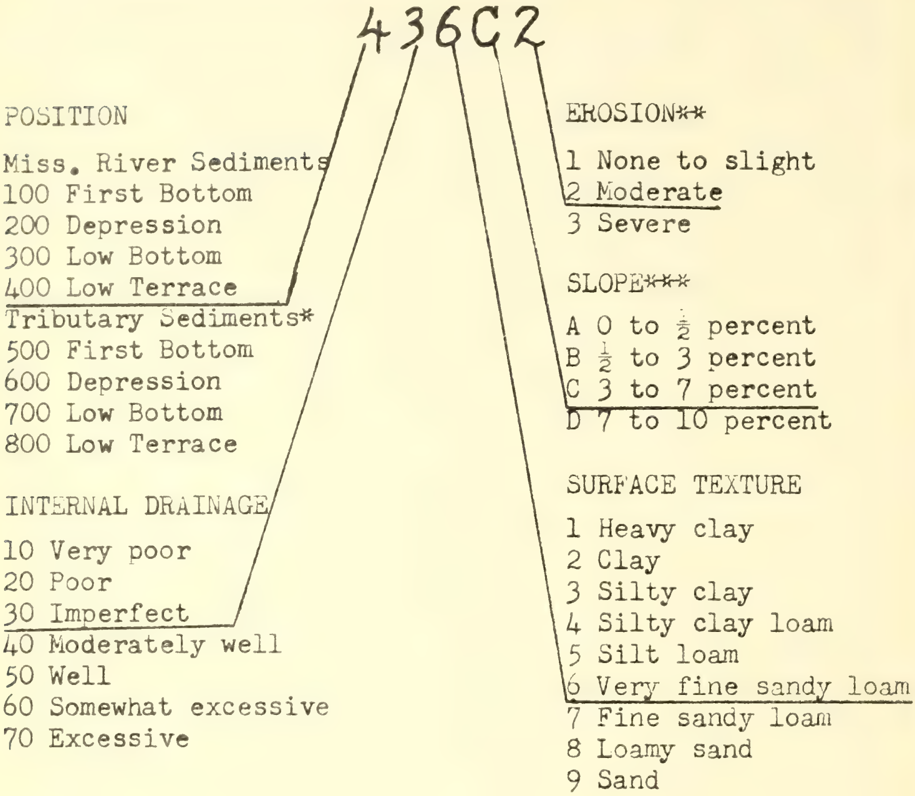
1. Note Symbols—The first step in using this bulletin is to examine your soil map and become familiar with the various symbols used to designate certain features. Each kind of soil mapped is indicated on the map with a symbol. This symbol is composed of three numbers. The first number in the symbol refers to the position of the soil and the source of sediments, the second to internal drainage and the third to the texture of the surface. For example, an area marked with the symbol 322 is a soil that has developed from Mississippi River alluvium and occupies a low bottom position, has poor internal drainage, and has a clay surface texture.

The slope and erosion of the area are indicated on the soil map by letters and numbers that follow the soil number. For example, the symbol 322C2 indicates the soil is on a C (3 to 7%) slope and has a 2 erosion (moderately eroded).

The diagram on page 6 explains the numbers and letters found on the soil maps.

Overwash phases are indicated on the soil map by a plus sign. For example, 326+ represents a shallow soil, ranging in thickness from 6 to 12 inches, that is underlain by clay, or silty clay.

Shallow phases of soil types are indicated on the soil map by underscoring the soil type number. One line under the soil type number indicates the soil rests abruptly on clay or silty clay at a depth ranging from 12 to 24 inches. Two lines under the soil type number indicates the soil rests abruptly on clay or silty clay at a depth ranging from 24 to 48 inches. The number 322° denotes a shallow



POSITION

Miss. River Sediments
100 First Bottom
200 Depression
300 Low Bottom
400 Low Terrace
Tributary Sediments*
500 First Bottom
600 Depression
700 Low Bottom
800 Low Terrace

INTERNAL DRAINAGE

10 Very poor
20 Poor
30 Imperfect
40 Moderately well
50 Well
60 Somewhat excessive
70 Excessive

EROSION**

1 None to slight
2 Moderate
3 Severe

SLOPE***

A 0 to ½ percent
B ½ to 3 percent
C 3 to 7 percent
D 7 to 10 percent

SURFACE TEXTURE

1 Heavy clay
2 Clay
3 Silty clay
4 Silty clay loam
5 Silt loam
6 Very fine sandy loam
7 Fine sandy loam
8 Loamy sand
9 Sand

*Soil numbers on the soil map in this group are preceded by the letter T.

**Soil numbers on the soil map without erosion designation indicate 1 erosion (none to slight erosion).

***Soil numbers on the soil map without slope designation indicate A slopes.

How soils are numbered

phase of the soil type indicated in the soil type number; essentially it is a heavy clay soil some 18 inches deep over coarse sand.

Other symbols used on the soil map are shown on page 7.

2. **Entire Soil Profile Important**—Soil types are separated on the basis of the character of the soil to a depth of 40 inches or more, not on the surface alone. Frequently two soils have the same surface texture, but differ widely in the subsoil, and therefore have different land uses and agricultural values. It is important that subsoil characteristics be understood.

Figure 2 shows Dundee silty clay loam (number 434 on the soil map) to a depth of 40 inches. The surface, or plow layer, is about 6 inches thick. Beneath the

∼	DEFINITE SOIL BOUNDARY LINE
⋯	GRADUAL SOIL BOUNDARY LINE
← →	TIE SYMBOL, connects two areas of the same soil type.
—··—	SMALL NATURAL DRAIN
—·—·	SHALLOW DUG DITCH
—·—	DEEP DITCH, either dug or natural
≈	RIVER OR STREAM
○	LAKE
▨	INTERMITTENT LAKE
=∷=	NATURAL INTERMITTENT STREAM
∼	SMALL, NATURAL STREAM
⁂	WET SPOT
ıııııııı	VERY STEEP BANK
⁞⁞⁞⁞⁞⁞⁞	ARTIFICIAL LEVEE
━━	PAVED ROAD
——	GRAVEL ROAD
— —	DIRT ROAD
┼┼┼┼	RAILROAD
1 | 6 12 | 7	SECTION CORNER
— — —	COUNTY LINE
- - - -	STATE LINE
//////	CITY BOUNDARY
■	HOUSE
✝■	CHURCH
⚑	SCHOOL
▬	STORE
▲	COTTON GIN
⊖	INDIAN MOUND
⊞	CEMETERY
∴	SAND SPOT
—•—•	POWER LINE
⊢ ⊢	GAS LINE
◓	SAW MILL

Learn the above list of symbols so that they may be recognized on the soil map.

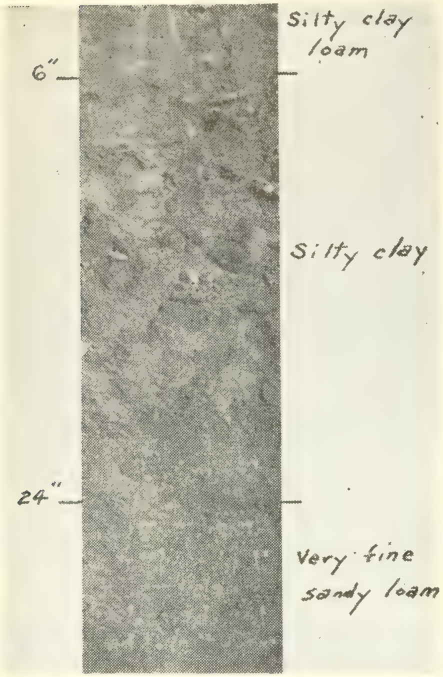


Figure 2. Profile of Dundee silty clay loam showing three different layers. The very fine sandy loam layer beneath the silty clay accounts for good internal flow of water.

surface is a layer of silty clay some 24 inches thick which slows down internal flow of soil water; however, beneath this layer of silty clay there is a layer of silty clay loam or a very fine sandy loam which allows water to pass readily after it comes through the silty clay layer. This layer of sandy material makes this soil much more desirable for row crop production.

3. **Soil Types Vary**—It is very important to understand that a soil may include a range of properties. Boundaries separating soil types are not always easily determined since some soil types may change within a few feet and others may change over a space of 100 feet or more. Between most types there is a zone in which properties common to both types are found.

In some areas soil types may occur in such a pattern that separation is not practical. When this condition was found a soil complex was mapped. Soil complexes are shown on the soil map as 160, 340, 420, 460, etc: (the soil number of a complex always ends with 0).

COMPARE YOUR YIELDS WITH TEST YIELDS

High yields year after year are the result of good soil and good management. Low yields may be caused by poor soil, bad management or by growing unadapted crops. Table 1 shows what yields can reasonably be expected from the soils of Bolivar County.

Actual production records must be kept to make yield comparisons. Unless yearly records are maintained the high yields are likely to be remembered and the low yields forgotten.

Practices that produce high yields of one crop, such as cotton, will not always produce high yields of other crops. Since cotton is the major crop, farmers will doubtless wish to point their management practices toward high yields of this important crop.

Since new crop varieties, new cultural practices and new plant diseases or insect pests may greatly affect yield levels in the future, the figures in Table 1 must be regarded as current.

KNOW WHAT GOOD SOIL MANAGEMENT MEANS

The following discussion of soil management is applicable to all soils in Bolivar County. Specific recommendations for soil types may be found in "Soil Groups of Bolivar County, Their Use and Management," page 15.

1. **Drainage**—Proper drainage is essential for efficient land use on all of the soils in Bolivar County. However, before extensive drainage systems are planned, the proper land use and productive

Table 1. Key to soil type, estimated acre yields, and land-capability class of soils in Bolivar County. (In columns A the estimated yields are those to be expected under good management practices. in columns B the estimated yields are those to be expected under management commonly practiced.[1])

Soil type No.	Soil type name	Land class	Cotton, lbs. lint per acre		Hybrid corn, bu. per acre		Soybeans, bu. per acre		Rice, bu. per acre	
			A	B	A	B	A	B	A	B
123	Mhoon sily clay	III	400	300	65	25	30	15	60	40
124	Mhoon silty clay loam	II	450	350	65	30	30	15	60	40
125	Mhoon silt loam	II	500	425	80	50	30	20	60	40
126	Mhoon very fine sandy loam	II	500	425	80	50	30	20	60	40
133	Commerce silty clay	II	550	450	70	30	30	20	----	----
134	Commerce silty clay loam	II	600	500	100	50	30	20	----	----
135	Commerce silt loam	I	750	550	110	60	35	25	----	----
136	Commerce very fine sandy loam	I	750	550	110	60	35	25	----	----
156	Robinsonville very fine sandy loam	I	825	700	110	65	35	25	----	----
157	Robinsonville very fine sandy loam	I	825	700	110	65	25	15	----	----
166	(no name) very fine sandy loam	II	550	450	75	35	20	10	----	----
167	(no name) fine sandy loam	II	550	450	65	35	20	10	----	----
174	Crevasse silty clay loam	IV	----	----	----	----	----	----	----	----
176	Crevasse very fine sandy loam	IV	----	----	----	----	----	----	----	----
177	Crevasse fine sandy loam	IV	----	----	----	----	----	----	----	----
178	Crevasse loamy sand	IV	----	----	----	----	----	----	----	----
179	Crevasse sand	VII	----	----	----	----	----	----	----	----
212	Dowling clay (depression)	IV	----	----	----	----	15	10	60	40
213	Dowling silty clay (depression)	IV	----	----	----	----	15	10	60	40
218	Dowling loamy sand (depression)	IV	----	----	----	----	----	----	----	----
T624	Dyer silty clay (depression)	III	----	----	----	----	15	10	60	40
234	Souva silty clay loam (depression)	II	450	300	80	30	25	15	----	----
235	Souva silt loam (depression)	II	500	350	90	30	25	15	----	----
236	Souva very fine sandy loam (depression)	II	500	350	90	30	25	15	----	----
312	Alligator clay	III	375	300	65	25	25	15	60	40
313	Alligator silty clay	III	375	300	65	25	25	15	60	40
314	Alligator silty clay loam	II	450	350	65	25	25	15	60	40
322	Sharkey clay	III	375	300	65	25	25	15	60	40
323	Sharkey silty clay	III	375	300	65	25	25	15	60	40
324	Sharkey silty clay loam	II	450	350	65	25	25	15	60	40
333	Tunica silty clay	II	500	425	70	30	30	15	----	----
424	Forestdale silty clay loam	II	450	350	65	30	25	15	60	40
425	Forestdale silt loam	II	500	425	80	50	25	15	60	40
T825	Brittain silt loam	II	550	450	90	60	25	15	60	40
433	Dundee silty clay	II	550	450	80	30	30	20	----	----
434	Dundee silty clay loam	II	600	500	100	50	30	20	----	----
T834	Pearson silty clay loam	II	500	400	80	50	25	15	----	----
435	Dundee silt loam	I	700	550	100	60	35	25	----	----
T835	Pearson silt loam	I	700	550	100	60	35	25	----	----
436	Dundee very fine sandy loam	I	700	550	100	60	35	25	----	----
T836	Pearson very fine sandy loam	I	700	550	100	60	35	25	----	----
444	Dubbs silty clay loam	I	700	550	100	65	35	25	----	----
445	Dubbs silt loam	I	825	700	110	65	35	25	----	----
T845	Dexter silt loam	I	825	700	110	65	35	25	----	----
446	Dubbs very fine sandy loam	I	825	700	110	65	35	25	----	----
T846	Dexter very fine sandy loam	I	825	700	110	65	35	25	----	----
454	Bosket silty clay loam	I	750	650	110	65	35	25	----	----
456	Bosket very fine sandy loam	I	825	700	110	65	35	25	----	----
457	Bosket fine sandy loam	I	825	700	110	65	25	15	----	----
464	Beulah silty clay loam	II	500	400	75	40	15	10	----	----
466	Beulah very fine sandy loam	II	550	450	75	30	15	10	----	----
467	Beulah fine sandy loam	II	550	450	65	30	15	10	----	----
468	Beulah loamy sand	IV	400	300	50	25	----	----	----	----
474	Clack silty clay loam	IV	----	----	----	----	----	----	----	----
476	Clack very fine sandy loam	IV	----	----	----	----	----	----	----	----
477	Clack fine sandy loam	IV	----	----	----	----	----	----	----	----
478	Clack loamy sand	IV	----	----	----	----	----	----	----	----
423	Forestdale silty clay	III	375	300	65	25	25	15	60	40

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[1] Estimated yields for soils on B slopes and those indicated in depressions. Soils on A, C, and D slopes usually produce lower yields for most row crops. Shallow and overwash phases of soil types not listed. Soils listed without estimated yields are not recommended for that particular crop.

capacity of the soil should be considered. Regardless of how much drainage is provided, unless the crop is adapted to the soil, low yields may be expected.

If the soil map is used as a guide, a system of natural surface drainage can be provided for each farm. Depressional soils should be used as locations for ditches if possible. These soils occupy the natural drainage pattern and usually make low yields. The type of ditch used should be governed by the size of the watershed area. Surface run-off from sandy soils is much less than that from clay soils; therefore, it will be necessary to provide larger ditches for clay soils than for the sandy soils. Occasionally it is necessary to cut ditches across ridges, but this practice should be avoided if possible.

2. Field Layout and Row Direction—Where practical, field boundaries should be placed on soil boundaries that separate soil types requiring different types of treatment. Fertilizer treatments, and other management practices suitable for the entire area can then be planned.

Where possible, roads and turn rows should be located on soil boundaries. Roads that cross soil boundaries, rather than follow them, tend to divide the field into smaller units. The boundaries of soils on undulating and sloping topography, as well as bayou and stream banks, are ideal locations for roads.

Row direction is important, and should be governed by the soil type, slope of the land and method of tillage. Soils on level slopes require row direction that allows for best possible run-off. On poorly drained soils it is usually the best practice to provide row direction so that each row will carry to an outlet the excess water that falls on the soil. This, of course, should not be done where there is danger of erosion. Imperfectly, moderately well, well, somewhat excessively and excessively drained soils on gently undulating, undulating and sloping topography should usually have rows running on the contour in order to conserve moisture and prevent excessive erosion. Generally speaking, rows should run parallel to the natural streams, bayous and small ridges.

Where mechanized methods of tillage are to be used, long rows are more efficient. The length of the rows should be governed by the soil boundaries and the slope of the land.

3. Fertilization—Nitrogen has long been recognized as the main fertilizer element lacking in all Bolivar County soils. Addition of nitrogen and organic matter to the soil increases the production of non-legume crops. The incorporation of organic matter in soils with undesirable physical characteristics always results in easier tillage and higher yields. Properly inoculated legume crops and manure provide an excellent source of both nitrogen and organic matter. Crop residues plowed under are also important in keeping the soil in a good, mellow condition and in increasing the rate at which it will absorb water.

Experimental work with phosphorus and potassium fertilizer on most Delta soils has shown very little need for these minerals That does not mean that in years to come Delta soils will not be depleted of their phosphorus and potassium supply. The sediments from which the soils of Bolivar County were formed were rich in these minerals, and a continuous cotton type of farming has removed little of these elements. With a change in the type of agriculture in which more hay and grain crops are grown, these elements will be removed from the soils much faster. Deficiencies should occur first in the soils of the low terrace group and it is here that the farmer should watch for deficiency symptoms and reduced yields. In many cases reduced yields are caused by poor physical condition of the soil. This condition must be corrected before crops can make the most efficient use of the fertilizer.

Proper soil analysis can serve as a good indicator of soil fertility; therefore the farmer should have his soil tested in the laboratory and use this information in developing specific fertilization practices in his fields.

Lime has not been generally recommended in this county. Lime is not necessary on any of the first bottom soils as they range in reaction from neutral to alkaline. Most of the low bottom soils range in reaction from medium acid to neutral, which is suitable for most crops grown locally. Low terrace soils are generally the most acid of all the soils in the county, but usually do not require the addition of lime for most commonly grown row crops. Depressional soils do not require the addition of lime for most crops grown locally. The need for lime should be established before it is applied. It should be remembered, if lime is to be applied, that a sandy loam soil with the same degree of acidity as a heavy clay soil requires only one-half the amount of lime to accomplish the same result. The acidity in the topsoil and the texture of the soil are the two factors that govern the amount of lime necessary to adjust the reaction.

Current fertilizer recommendations of the Mississippi Agricultural Experiment Station should be consulted each year for up-to-date fertilizer information.

KNOW SPECIFIC PROBLEMS OF YOUR SOILS

Study your soil map and identify all of the soil types occurring on your farm. Use the soil map to help you understand your soils and their crop adaptations.

On most farms there are variations in soil conditions. One soil may be best suited to pastures, but poorly suited to cotton. If readjustment of the farm enterprises is planned, a study of the soil map will be very valuable to any farmer or operator.

Each soil condition has problems that may or may not be general in all of your soils. All of your soils may have the same surface texture. But some of these soils may be very poorly drained, some may be poorly drained, some may be imperfectly drained or some may be moderately well drained. These different degrees of internal drainage will affect crop adaptation. On the other hand, internal drainage may be similar in all of your soils with surface texture varying from a silty clay to a very fine sandy loam. Surface texture variation affects cultural practices and choice of crops.

Slope of each soil condition poses problems in row direction, field boundaries and surface drainage. Poor internal drainage becomes less of a problem when the slope of the area allows surface water to move off quickly. Proper row direction on poorly drained soils greatly improves surface drainage.

Many fields in Bolivar County have two or more soils with widely varying characteristics requiring different types of crops and management. When the area of one soil is very small it is often necessary to farm it the same way as the major type or types. Where the area of different types is large enough, each can be managed separately and devoted to its best permanent use.

Make Your Own Farm Plan

If you are a farmer you are concerned in a special way with the land on your farm. No doubt you know a good deal about some of the different kinds of land that you are farming. It is important that you know the main good and bad points about all of your land. It is easy to recognize "sandy land" or "buckshot land" but more difficult to recognize the variations of these two broad classes of land.

A soil map is a farmer's inventory of his land. To figure the best uses for each kind of land, without a soil map, takes a lot of time, study and in some cases, costly experience. Even for farmers who have studied their soils, a good soil map will usually help to explain some of the things that they have observed from year to year.

This part of the bulletin is written for the farmers who are interested in studying their soil maps to develop logical and profitable farm plans.

There are several ways a soil map will help you develop a good land use plan. From it you can decide what type of farm enterprises are best suited to your soils. It can be used as a guide in planning surface drainage. Ditches, if possible, should be located in the depressional soils. Row direction, which is important in this county, should be governed by the soil type. Field boundaries, in the proper location, will result in lower production costs. If field boundaries are located properly, soils within the boundary of the field will be similar and will respond to similar use and practices. Improperly placed field boundaries will result in delayed cultivation, inefficient use of fertilizer and variable yields and dates of maturity

To illustrate the use of a soil map in farm planning a 200-acre farm has been selected. On this farm quite a large percentage of the land is poorly drained with heavy subsoil and surface texture. In years past, most of this land has been planted to cotton, with usually poor results, although land on the farm that is adapted to cotton has made good yields.

It is realized that other uses could be made of the soils on this farm. However, it is thought that a combination cotton and livestock program is best suited to the soils on this farm. Approximately 130 acres are best adapted to pasture and approximately 60 acres best adapted to cotton or corn.

Figure 3 shows the plan used by the owner in 1950. Generally, this has been the cropping system for the past several years.

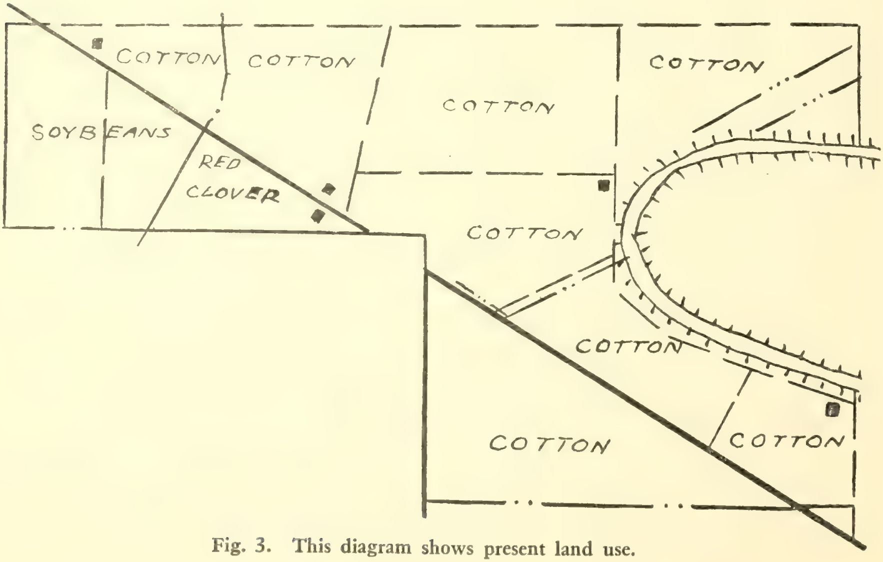

Fig. 3. This diagram shows present land use.

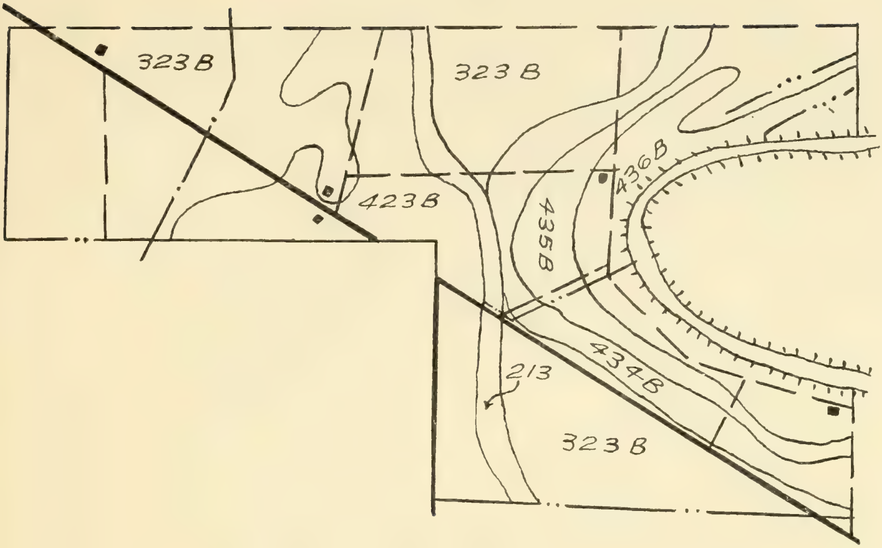

Fig. 4. Soil map of 200-acre farm.

Figure 4 shows the soil map of the farm. The soil numbers 323B and 423B indicate that the soil has poor internal drainage and a silty clay surface texture. This means much of the rainfall has to be carried off the surface of the land, as movement of water is slow through the heavy subsoil. The silty clay surface texture means that the soil will be difficult to work and handle. The number 213 indicates a depressional soil that accumulates water from the higher adjacent land. This soil is poorly drained and has a heavy surface texture, which makes it difficult to use for row crops. The numbers 434B, 435B, and 436B indicate soils with fairly sandy subsoils that allow soil water to move fairly well through the soil profile. This means that less water will accumulate on the surface. The surface texture of these soils, silty clay loam, silt loam and very fine sandy loam, respectively, insures easy land preparation and cultivation. These soils have a wide range of crop adaptability and are the best row crop soils on the farm.

Figure 5 shows the plan of more desirable uses of the soils. Permanent field boundaries have been established to include similar soils in each field. Row direction is indicated on the map. Each field is numbered to facilitate easy reference to the plant or crop proposed. On this farm a heavy infestation of Johnson grass is used in establishing pasture. The recommendation in Table 2 shows the acres and the proposed cropping system for each permanent field. It will be noted that no additional drainage facilities are provided as the system is adequate for the proposed plan. Figure 5 shows the changes made in the field roads and tenant house locations. Farm boundaries are good locations for field roads. Soil boundaries, especially where soils on steep slopes have been separated, are good locations for roads. Tenant houses should be located in corners of fields where they least affect the normal operations required in working the land.

It is realized that all of the items listed in the cropping calendar cannot be accomplished in one year, but must be adjusted to fit the individual.

Table 2. Cropping Calendar: Seed and Fertilizer Recommendations.

Field No.	Acres	1951	1952	1953	1954	Seeding Recommendations	Fertilizer Recommendations
1	28	Cotton, followed by vetch	Continue	Continue	Continue	Cotton—1 bushel per acre Vetch—30 pounds in Sept.	Good growth of vetch plus 30 lbs. nitrogen
2	30	Cotton, followed by vetch	Continue	Continue	Continue	Cotton—1 bushel per acre Vetch—30 pounds in Sept.	Same as field No. 1
3	28	Soybeans, followed by fescue and ladino clover	Continue	Continue	Continue	Fescue—10 lbs., 8" drills Ladino clover—1 lb. broadcast after fescue is up to a stand in Sept. and Oct.	30 lbs. nitrogen when planted, 60 lbs. nitrogen following Oct.
4	19	Soybeans, followed by wheat	(Wheat) millet, followed by wheat	(Wheat) millet, followed by wheat	(Wheat) millet, followed by wheat	Wheat—2 bushels. Millet—10 lbs., 40 inch rows.	Wheat—60 lbs. nitrogen when planted and 30 lbs. nitrogen in March after grazing Millet—60 lbs. nitrogen
5	8	Soybeans, followed by red clover	Red clover on Johnson grass	Continue	Dallis grass and lespedeza	Red clover—15 lbs. broadcast in October Dallis grass—15 lbs. March Lespedeza—15 lbs. March	Same as field No. 6
6	9	Soybeans	Dallis grass and lespedeza	Continue	Continue	1½ bushels soybeans in May Dallis grass and lespedeza—see field No. 5	Dallis grass—30 lbs. nitrogen first of June and 30 lbs. nitrogen in September
7	26	Soybeans, followed by red clover	Red clover on Johnson grass	Continue	Dallis grass and lespedeza	Red clover—15 lbs. broadcast Dallis grass and lespedeza—see field No. 5	Same as field No. 5
8	9	Red clover (on Johnson grass) seeded in fall of 1950	Continue	Dallis grass and lespedeza	Continue	Dallis grass—15 lbs. March Lespedeza—15 lbs. March Red clover, previously seeded	Same as field No. 6
9	36	Soybeans, followed by fescue and ladino clover	Continue	Continue	Continue	Same as field No. 3	Same as field No. 3
10	7	Corn, followed by vetch	Continue	Continue	Continue	Corn—12 to 15" apart Vetch—30 lbs. in Sept.	Good growth of vetch plus 90 lbs. nitrogen

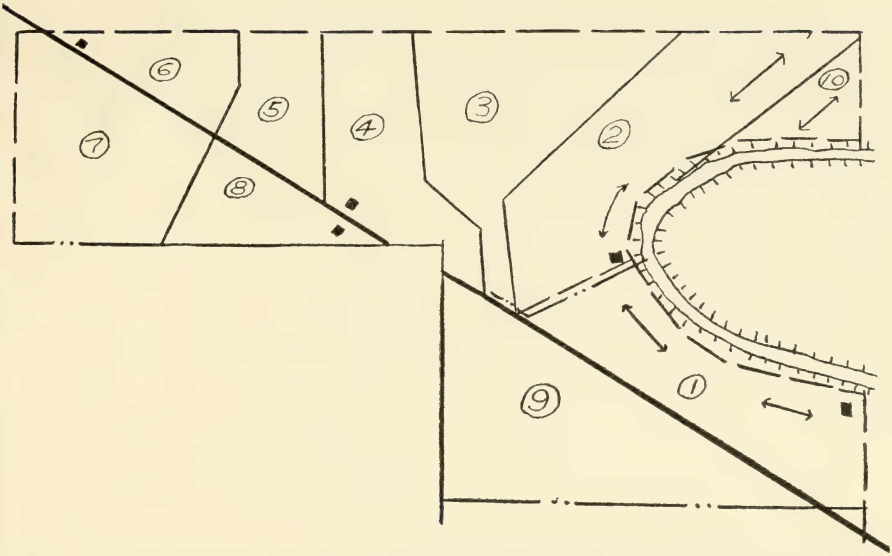

Fig. 5. Map of 200-acre farm with permanent field boundaries and row direction indicated.

Soil Groups Of Bolivar County, Their Use And Management

The soils of Bolivar County have been grouped into land-capability classes, based on the ability of the soil to produce permanently under specified use and treatment. Each land-capability class consists of soils that are essentially uniform with respect to crops or other plants that can be grown. The soils in this county have been grouped according to the system employed by the Soil Conservation Service, using eight land-capability classes for all the land in the United States. In this county we have only the following classes:

Class. I. Very good land that can be cultivated safely with ordinary farming methods.

Class II. Good land that can be cultivated safely with easily applied practices.

Class III. Moderately good land that can be cultivated safely with intensive treatment to control erosion, conserve moisture, and to furnish adequate surface drainage.

Class IV. Land good enough for occasional cultivation under careful management, but it is not suited for regular cultivation.

Class VII. Land suited for grazing or forestry with severe limitations. The soils in this class are excessively drained and occupy rather rough topography.

Within each of the above classes of soil, except Class I, there are sub-classes and land-capability units, based on the dominant hazard involved and on the treatment necessary. The principal hazards are erosion, indicated by the letter "e"; excess water, indicated by the letter "w"; and some special soil condition, indicated by the letter "s". Except for Class I land, all of the soils in this county have one or more of the above hazards. For example, Class IIe indicates that erosion is the main hazard in this group. Because of differences in physical characteristics all of the soils with erosion hazards cannot be grouped together. Some must be treated differently. Therefore, land-capability units, which are groups of soil types and phases that require the same treatment, have been established. These land-capability units are indicated by numbers following the letter that indicates the dominant hazard. For example, Class IIe1 and IIe2 have the same capability, the same dominant hazard, but require different treatments. Class IIs1 has the same capability as those previously mentioned, but has a different hazard—a condition within the soil that requires special treatment.

Following is a description of the Land Classes and the suggested treatments.

Class I. This is gently undulating, well drained, sandy land. This land is excellent for row crops, grass and hay, forest and wildlife. It is well adapted to all crops grown in this area, with the exception of rice. It may be row cropped annually, followed by winter legumes. This land is adapted to Dallis grass, lespedeza, crimson clover, Sudan grass, millet and is well suited to winter grazing. It is well adapted to most grass and legume mixtures. This is the best land in the county for the production of cotton. Row direction should be on the contour.

The following soils are in this group: 135B, 136B, 435,B, 436B, T835B, T836B, 444B, 445B, 446B, T845B, T846B, 454B, 456B, 457B, 156B, 157B. Shallow phases (clay at 12 to 24") only of 166B, 167B.

Class IIe1. This is undulating, well drained, sandy land. The slope ranges from 3 to 7 percent. This land is very good for row crops, grass and hay, forest and wildlife. It is well adapted to all crops grown in this area, with the exception of rice. To prevent erosion, all tillage operations should be on the contour. Rotations of two years of row crops, followed by two years of close growing crops are suggested. This land is well adapted to most grass and legume mixtures grown locally, and well suited for winter grazing.

The following soils are in this group: 136C, 157C, 435C, 436C, 445C, 446C, 447C, 456C, 457C, T835C, T845C, T846C.

Class IIw1. This is depressional land where the surface water from adjacent higher land tends to accumulate. With proper surface drainage this land is adapted to most crops grown locally. Water moves through the subsoil fairly well. It is not well adapted to deep-rooted perennial legumes, but is fairly well adapted to cotton, corn and soybeans. It is well adapted to fescue and white clovers, Dallis grass and lespedeza and is well suited to temporary summer annuals for summer grazing.

The following soils are in this group: 234, 235, 236.

Class IIs1. This is gently undulating, imperfectly drained land with fairly heavy textures. It is excellent for grass and hay and is very good for cotton and corn. It is well suited to sericea, alfalfa and other deep-rooted perennials. Small grains, lespedeza and soybeans are well adapted to this land. Rows should usually run on the contour. It is well adapted to most grass and legume mixtures grown locally and is suitable for winter grazing.

The following soils are in this group: 133B, 134B, 333B, 433B, 434B, T834B.

Class IIs2. This is gently undulating, rather cold natured land with light surface textures. Surface drainage is usually necessary on this land. The subsoil is fairly heavy which accounts for the slow internal movement of water. Row direction should be such that excess water is removed. This land is adapted to soybeans, small grains, and most grass and legumes mixtures grown locally. It is fairly well suited to cotton and corn. Row crops should be followed by winter legumes and it is suggested that rotations that include one-half of the land in close-growing or sod crops be used in order to maintain the fertility level and improve the physical condition of the soil. Irrigation can be practiced on this land without serious loss of water.

The following soils are in this group: 125+B, 126+B, 126B, 125B, 325+B, 326+B, 420B, 425B, T825B.

Class IIs3. This is gently undulating, somewhat excessively drained land. This land is well adapted to early truck, early corn and small grains. It is fairly well suited to cotton, soybeans, and other summer annuals, but in dry years these crops are apt to suffer for moisture. When used for row crops it is suggested that one-half of the land be planted to sod crops to increase the organic matter content and to maintain the fertility level. Winter legumes should follow row crops. Bermuda grass in combinaion with crimson clover is adapted to this land. It is well adapted to small grains and winter grazing. Frequent fertilization is necessary to produce good grazing over long periods.

The following soils are in this group: 160B, 166B, 167B, 460B, 464B, 466B, 467B. Shallow phases (clay at 12 to 24") only of 177B, 178B.

Class IIs4. This is gently undulating, poorly drained land with fairly heavy surface textures and heavy subsoil. This land is excellent for rice, grass and hay. It is fairly well adapted to row crops. It is well suited to small grain, soybeans and lespedeza. When used for row crops it is suggested that one-half of the land be used for sod or close-growing crops to maintain the fertility level and to improve the physical condition of the soil. Row direction should be such that excess water is carried to adequate outlets. This land is well adapted to fescue and white clover, Dallis grass and lespedeza or Johnson grass and red clover.

The following soils are in this group: 124B, 424B, 324B, 314B.

Class IIIe1. This group of soils is similar to Class IIe1, differing in having moderately eroded surfaces. Badly eroded areas should be left in permanent sod. All land preparation for row crops should be done in the spring on the contour. Row crops should be followed by winter legumes. Perennials, such as sericea, are well adapted to this land. This land is well suited to winter grazing.

The following soils are in this group: 136C2, 456C2, 457C2, 436C2, 446C2, 435C2, T835C2, T845C2.

Class IIIe2. This group of soils is similar to Class IIs1, differing in occurring on steeper slopes. These soils occur on slopes ranging from 3 to 7 percent; consequently, they are subject to more erosion than those in Class IIs1, but are adapted largely to the same crops. Contour tillage should be practiced and it is suggested that rotations be used that include row crops for one year and sod or close-growing crops for two years. Deep-rooted legumes, such as alfalfa or sericea are well adapted to this land. The soils in this group are well suited to winter grazing.

The following soils are in this group: 134C, 333C, 333C2, 434C, 434C2, 433C.

Class IIIe3. Soils in this group are similar to those in IIs2, but occur on steeper slopes, ranging from 3 to 7 percent. Contour tillage, and the use of close-growing or sod crops are suggested to prevent excessive erosion. Row crops should be followed by winter legumes. This land is well adapted to fescue and white clovers, Dallis grass and lespedeza and Bermuda grass and wild winter peas. It is well adapted to winter grazing.

The following soils are in this group: 420C, 425C, 425C2.

Class IIIe4. This group of soils is similar to the soils in IIIs2, but differ from them by occurring on steeper slopes. The slopes range from 3 to 7 percent. Some of the soils in this group are moderately eroded. All tillage practices should be performed on the contour and it is suggested that rotations be used that include two years or row crops followed by two years of sod or close-growing crops. Rice is not recommended on these soils because of the slopes, but otherwise the same crops are adapted to this group of soils and group IIIs2.

The following soils are in this group: 312C, 312C2, 313C, 313C2, 423C, 423C2, 323C, 323C2, 322C, 322C2, 340C, 340C2.

Class IIIw1. Soils in this group are similar to those found in Class IIs2, but differ from them by occurring on level slopes. This land always needs artificial drainage. Soybeans, lespedeza, fescue and white clover and summer annuals for summer temporary grazing are best adapted to this land. Rice is well adapted to this land, but usually the size of the area is too small to be used for that purpose. If this land is properly drained it is fairly well suited to cotton, corn and small grains.

The following soils are in this group: 425.

Class IIIw2. Soils in this group are similar to those in IIs4, but differ from them by occurring on level slopes. This land is best adapted to grass and hay crops and is well adapted to summer temporary grazing crops. It is suitable for rice, but usually the size of the area is so small that it would not be practical to use it for that purpose. This land is not well adapted to cotton or corn. Artificial drainage is always needed to utilize this land.

The following soils are in this group: 424.

Class IIIw3. This is low, poorly drained, depressional soil. Water accumulates on this land from adjacent higher land. Artificial surface drainage with adequate outlets is necessary before these soils can be utilized. This land is adapted to small grains, soybeans, silage crops and temporary summer grazing, if adequate surface drainage is provided. It is not adapted to cotton and corn. Fescue and white clovers and Dallis grass and lespedeza do well on these soils. In many instances these soils must be farmed in the same manner as the adjoining soil, due to the limited acreage they occupy.

The following soils are in this group: 210, T624.

Class IIIs1. These soils are similar to those in Class IIs3, but differ from them by occupying steeper slopes. Some soils in this group are also moderately eroded. The same crops are adapted to both groups. Contour tillage should be used to conserve moisture and to prevent erosion. All land preparation should be performed in the spring. Frequent applications of fertilizer are necessary to produce highest yields.

The following soils are in this group: 160C, 160C2, 167C, 467C, 467C2, 466C2, 460C, 460C2.

Class IIIs2. This is gently undulating, poorly drained land with heavy textures in both surface and subsoil. It is well adapted to rice, grass and hay. It is not well suited to cotton and corn, but is fairly well adapted to small grains and is well adapted to lespedeza and soybeans. When this land is used for row crops rotations should include two years out of four in sod or close-growing crops in order to maintain the fertility level and improve the physical condition of the soil. This is excellent land for fescue and white clovers, Dallis grass and lespedeza and Johnson grass and red clover. Shallow ditches are usually necessary to remove excess surface water. Row direction should be such that each row will carry the excess water to adequate outlets.

The following soils are in this group: 312B, 313B, 123B, 322B, 323B, 322°B, 423B, 340B.

Class IVe1. This is land with short, steep slopes with some of the topsoil removed by erosion. It has a moderately light subsoil through which water moves fairly well. Only occasionally, if at all, should this land be in row crops. It is necessary that all tillage operations be on the contour to prevent loss of soil by erosion and to conserve moisture. This land is adapted to most row crops, but because of its slope its best use is permanent sod or deep-rooted perennials.

The following soils are in this group:

456D, 444D, 435D, 436D, 435D2, T835D, 460D, 460D2.

Class IVe2. This is heavy land with short steep slopes with not more than moderate erosion. It is suited to limited row cropping, because of the heavy nature of the soil and the steep slopes it occupies. All tillage operations should be on the contour and rotations should include grass and legume sod three years out of four. Its best use is pasture or forest. Fescue and white clovers, Dallis grass and lespedeza and red clover and Johnson grass are suitable combinations that do well on this land.

The following soils are in this group: 333D2, 312D2, 312D, 340D, 340D2, 424D, 434D, 434D2.

Class IVw1. This is the land that is in cultivation between the Mississippi River and its levee. It is subject to backwater and overflows of long duration. The soil is deep, alkaline, with variable textures in the surface and subsoils. It is very productive and is adapted to most crops grown locally. The hazard of overflows prevents this soil from being used profitably in most cases. Crops on this land should include those which can be planted late and mature early. Its best permanent use is forest.

All soil numbers on the soil maps are followed by the letter "f" to indicate the hazard of prolonged overflows.

Class IVw2. The soils in this group are similar in characteristics to the soils in Class IIIs2, but differ from them by occupying level slopes. To use these soils for row crops requires extensive artificial drainage systems. They are not well adapted to cotton or corn, but with adequate drainage will produce fair yields of soybeans. They are well adapted to pasture or forest. Fescue and white clovers, Dallis grass and lespedeza are suitable pasture combinations. This is excellent land for rice.

The following soils are in this group: 323, 322, 313, 312, 423.

Class IVw3. This is very poorly drained, depressional land that accumulates water from the adjacent higher land. This land has heavy textures in the surface and subsoils, and is adapted to soybeans, grain sorghums and other hay and silage crops. It is not recommended for cotton or corn, but may be used for rice. It is well adapted to fescue and white clovers and Dallis grass and lespedeza. It can often be profitably used for summer temporary grazing. This land occupies the natural drainage pattern of the land and, if possible, all drainage ditches should be located in these soils.

The following soils are in this group: 212, 213, 218[1].

Class IVs1. This is gently undulating to undulating, droughty, sandy land with light surface textures. The subsoil allows water to move through it rapidly. It is fairly well suited to early truck crops, early corn and small grains. It is not adapted to cotton, corn or soybeans. Fertilizer applications should be frequent, due to the rapid leaching of the soil. It is difficult to establish to permanent pasture. Bermuda grass is the best adapted grass.

The following soils are in this group: 177B, 177C, 178B, 176B, 470B, 477B, 477C2, 478B, 478C, 478C2, 474B, 473B, 174B, 138B, 476B, 468B, 468C2.

Class VIIs1. This is gently undulating, very droughty, sandy land. Subsoil allows the soil water to move rapidly. This land is the result of the flood of 1927 that deposited sand in varying depths over the original soil. The topography is rough. This land is not suited to row crops or pasture, but is best adapted to woodland, wildlife and very limited grazing. Native grasses and shrubs should be encouraged to provide all ground cover possible.

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[1] The soil, indicated on the soil map by the number 218, received a shallow deposit of loamy sand some 15 inches deep, over the original soil, which was 212.

The following soils are in this group: 179B, 170B.

Alluvial Soils Unclassified: This is land in forest between the Mississippi River and its levee. No attempt was made to delineate soil conditions in this area. Due to the hazard of overflow this land should remain in forest.

How Bolivar County Soils Were Formed

This section of the bulletin is written for those who are interested in knowing something of the origin of the soils on their farms. An understanding of the following information is not essential for good land use and farm management, however, knowledge concerning the formation of the soils on his farm may help the farmer get a better idea of his soil map.

Origin of Soil Materials—All of the soils of Bolivar County are composed of sands, silts and clays transported by the Mississippi River. Examining a map of the United States on which the Mississippi River and its tributary system is shown will indicate the complexity of the sediments from which the soils were formed. Sediments (sand, silt and clays) transported by any stream entering the Mississippi River north of Bolivar County may easily have been dropped within the county. In general, then the soils of this county are a combination of sands, silts and clays from some 20 states lying between the Rocky Mountains on the west and the Appalachian Mountains on the east and north of Bolivar County. In other words, the soil locally called "mixed land" may be made up of sands from the hills of Kentucky, silts from the glacial section of Montana and the clays from the prairie sections of Iowa.

How the Soils Were Formed—The present and past activity of the Mississippi River is directly responsible for all of the soils in the county. The Mississippi River is a mature stream and such streams have very definite habits. A study of these habits is necessary for the understanding of soil formation in this county. A mature stream such as the Mississippi River maintains the same gradient or fall throughout the years and in order to do this, it must be cutting into the bank on one side and filling in on the other side. This cutting and filling causes the channel of the river to shift back and forth over its flood plain. Since the building of the first artificial levee system, this shifting back and forth or meandering has been more or less confined to the area in between the levees. Before the levees were constructed, the river shifted back and forth over the entire flood plain. Lake Bolivar is a good example of the river channel several hundred years ago.

In the flood plain of a mature stream there are annual overflows and it is at the time of these overflows that the sediments, from which the soils are formed, are deposited. The swiftness of the overflowing water determines whether or not sands, silts or clays are dropped. If the water is moving fast, the heavy sediments are dropped; namely, the sand and silts, and if the water is moving slowly or has stopped, the lightest sediments, namely, clays, are dropped. A combination of sediments are deposited by waters that move at a moderate speed. Essentially then the texture (the amount, sand, silt or clay) of the sediments are determined by the rate at which the flooding water flows. Since the particle size of the sands and silts is larger than that of the clays and the rapid floodwater deposits these sediments, any mature stream over a period of years of normal flooding tends to build up along its channels high banks of sand and silt called natural levees. These natural levees give rise to two groups of soil; namely, the First Bottom group and the Low Terrace group. The First Bottom group is made up of those soils on the recent natural levees that receive frequent overflows and have remained alkaline or "sweet." Along the present artificial levee, areas of soil are found that have remained alkaline or "sweet" because of seepage that occurs when the water level on the inside of the levee is high. These seep waters fall into the same first botom group as the soils that receive normal overflow annually. The Low Terrace group of soils occur on the old natural levees found along the old river scars (ox-bow lakes or bayous) without active channels. These areas have remained above the overflow stage long enough for the soil to become leached or acid, and long enough for the forces of nature which start soil development to begin to work. On the soil map the first bottom group has its numbers begin with "I" and the low terrace group begins with "4."

Since most of the sand and silts are deposited along stream banks or on natural levees, the sediments that remain suspended in the flood water are clay. This clay is dropped after the water has slowed down or stopped, thus giving rise to another group of soils, the Low Bottom group. The soils of this group occur in the broad backwater of slackwater areas and are composed of heavy clay and clay sediments. These soils are commonly called "buckshot" soils and on the soil map have their soil number begin with "3."

The annual rainfall for the county is approximately 55 inches and at times of heavy rainfall several inches of water may fall in a 24-hour period. When the rain falls on the Mississippi River floodplain, it tends to collect in the low swags or depressional areas and remain there until it can find a way out through the natural or artificial drainage systems. These low swags or depressional areas give rise to another group of soils, the depressional group, denoted on the soil map with the first number as a "2." These areas received sediments from the surrounding slopes and ridges washed in by the rainwater and also receive backwater flooding when the river is at floodstage. This type of flooding deposits sediments with wide textural variations, thus giving rise to soils with widely varying characteristics.

Soil Series, Types And Phases Of Bolivar County

MHOON SERIES

The Mhoon series includes alluvial soils derived from light and heavy textured Mississippi River alluvium. They occur in relatively small areas adjacent to the river, or former channels of the river. The Mhoon series occupies the poorest drained position in the Robinsonville (well-drained)-Commerce (imperfectly drained)-Mhoon (poorly drained) group. They occupy gently undulating topography, and are neutral to alkaline in reaction.

Soil types and phases within the Mhoon series:

123 Mhoon silty clay
124 Mhoon silty clay loam
125 Mhoon silt loam
126 Mhoon very fine sandy loam

SOIL PROFILE: (125 Mhoon silt loam). The surface layer is a pale brown, friable silt loam 4 to 6 inches deep. Below the surface layer down to 15 to 20 inches deep is a light gray, friable silt loam, mottled with various shades of yellow and brown. From 20 to 40 inches deep is a light gray silty clay or silty clay loam, mottled with various shades of gray and brown. The profile is neutral to alkaline throughout. Other than a difference in texture of the surface, the other types in this series are essentially the same as Mhoon silt loam. In Mhoon silty clay and silty clay loam the profile tends to be somewhat heavier throughout than in Mhoon silt loam.

COMMERCE SERIES

The soils of the Commerce series are imperfectly drained alluvial soils derived predominately from light-textured Mississippi River alluvium. They occupy the intermediate position in the Robinsonville (well-drained)-Commerce (imperfectly drained)-Mhoon (poorly drained) group. They occur in relatively small areas and occupy gently undulating to undulating topography. They are neutral to alkaline in reaction.

Soil types and phases within the Commerce series:

133 Commerce silty clay
134 Commerce silty clay loam*
135 Commerce silt loam*
136 Commerce very fine sandy loam*
138+ Commerce loamy sand, overwashed phase (loamy sand 8 to 20 inches deep).

SOIL PROFILE: (Commerce silt loam 135). The surface layer is a grayish brown, friable silt loam 4 to 6 inches deep. Below that depth down to 20 inches is a light brownish gray silt loam, faintly mottled with shades of yellow and brown. From 20 to 40 inches is a brownish gray, friable silt loam, mottled with shades of yellow and brown. The shallow phases of this soil are indicated in the soil numbers. Other than a difference in surface texture, the types within this series are essentially the same as Commerce silt loam. The Commerce silty clay and silty clay loam are usually somewhat heavier in texture throughout the profile than the Commerce silt loam. These soils are alkaline throughout the profile.

ROBINSONVILLE SERIES

The Robinsonville series includes alluvial soils derived from light-textured Mississippi River Alluvium. They are the best drained member of the Robinsonville (well-drained)-Commerce (imperfecly drained)-Mhoon (poorly drained) group. They occur on relatively high elevations and occupy the first bottom position. They are found on gently undulating to undulating topography. They are neutral to alkaline in reaction throughout the profile.

Soil types and phases within the Robinsonville series:

156*Robinsonville very fine sandy loam
157 Robinsonville fine sandy loam

SOIL PROFILE: (156 Robinsonville very fine sandy loam). The surface layer is a yellowish brown friable very fine sandy loam 8 to 10 inches thick. Below that depth is a dark grayish brown to yellowish brown friable silt loam, ranging in thickness from 8 to 10 inches. Below this layer is a yellowish brown fine sandy loam ranging in thickness from 15 to 20 inches. Below this layer is a yellowish brown loose loamy sand. The profile is neutral to alkaline throughout. Other than shallow phases of this soil, the other types are essentially the same as Robinsonville very fine sandy loam, with slight variations in surface texture.

(NO NAME) SERIES

The soils of this series have not been named, but are indicated by the soil numbers. These soils are derived from light-textured Mississippi River alluvium. They occupy the first bottom position and are

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***Throughout this publication soils or groups of soils which occur in shallow phases in Bolivar County are marked with an asterisk.**

On the soil map of Bolivar County these shallow phases are identified as follows:

1. **A plus sign indicates soil is underlain by clay, silty clay or silty clay loam at depths from 6 to 12 inches.**
2. **Underscoring the soil number one time indicates soil is underlain by clay or silty clay at depths from 12 to 24 inches.**
3. **Underscoring soil number two times, indicates soil is underlain by clay or silty clay at depths ranging from 24 to 48 inches.**

neutral to alkaline in reaction. They occupy relatively high elevations and are found on undulating to gently undulating topography. They are somewhat excessively drained.

Soil types and phases within this series:

166 (no name) very fine sandy loam*
167 (no name) fine sandy loam*

SOIL PROFILE: (166 (no name) fine sandy loam). The surface layer is a dark brown friable very fine sandy loam, 8 to 10 inches deep. Below that depth is a very friable brown very fine sandy loam to fine sandy loam. The profile is neutral to alkaline throughout. The shallow phases of this soil are indicated in the soil numbers. Other than shallow phases and slight variations in surface texture, the other soils in this series are essentially the same as 166 (no name) very fine sandy loam.

CREVASSE SERIES

The soils of this series include excessively drained alluvial soils derived from light-textured Mississippi River alluvium. They occupy slopes ranging from undulating to gently undulating, occur on relatively high elevations and are a member of the first bottom group of soils. They are neutral to alkaline in reaction. Shallow phases of this soil are indicated in the soil numbers. They are found in relatively small areas near the Mississippi River.

Soil types and phases within the Crevasse series:

179 Crevasse sand
178 Crevasse loamy sand*
177 Crevasse fine sandy loam*
176 Crevasse very fine sandy loam
174 Crevasse silty clay loam

SOIL PROFILE: (178 Crevasse loamy sand. This soil is a yellowish brown very friable loamy sand from the surface down throughout the profile to a depth of 40 inches. The profile is neutral to alkaline throughout. Other than the shallow phases and variations in surface texture the other soils in this series are essentially the same as Crevasse loamy sand. Excessive internal drainage is the limiting factor in all the soils in this series.

SOIL COMPLEXES

A soil complex is a soil association composed of such an intimate mixture of areas of soil series, types, or phases that these cannot be separately indicated upon maps of the scale used. The soil association is mapped as a unit. In Bolivar County there are seven soil complexes, each having varying slope and erosion, composed of specific soil series, types and phases in association. Following is a brief description of each complex:

210 Dowling soils: These are poorly drained alluvial soils found in depressions and the old former runs of streams. The surface texture ranges from clay to silt loam with no uniformity of occurrence. They are derived partly from Mississippi River slack water deposits and partly from local alluvium washed from the lighter-textured series. Internal movement of water is very slow. They constitute a part of the natural drainage pattern and should be used as such if possible.

340 Sharkey-Clack soils: This group of soils includes two or more of the soils in the Sharkey, Tunica, Forestdale, Dundee, Dubbs, Boskett, Beulah and Clack series. Most of the area is heavy textured, poor to imperfectly drained, with small areas within the delineation of lighter-textured soil. This association is found on gently undulating, undulating and sloping topography.

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*Throughout this publication soils or groups of soils which occur in shallow phases in Bolivar County are marked with an asterisk.

On the soil map of Bolivar County these shallow phases are identified as follows:

1. A plus sign indicates soil is underlain by clay, silty clay or silty clay loam at depths from 6 to 12 inches.
2. Underscoring the soil number one time indicates soil is underlain by clay or silty clay at depths from 12 to 24 inches.
3. Underscoring soil number two times, indicates soil is underlain by clay or silty clay at depths ranging from 24 to 48 inches.

460 Dundee-Clack soils: This association is composed of two or more of the soils found in the Dundee, Dubbs, Bosket, Beulah and Clack series. Most of this area in Bolivar County is composed of Dundee, Dubbs, and Bosket soils with small areas of Beulah and Clack. There is no uniformity as to the arrangement of these soils, frequently changing from type of profile to another within a few feet.

420 Forestdale soils: These soils are derived from relatively light-textured Mississippi River alluvium. This complex is composed of Forestdale, Dundee and Dubbs series, with the Forestdale soils predominating. The Dundee and Dubbs soils occur in small mounds scattered throughout the Forestdale soils. The surface texture in this complex, as in all complexes, is variable.

470 Clack soils: This complex represents a very droughty, extremely sandy area. The texture of the surface ranges from a very fine sandy loam to a loamy sand. The internal drainage is predominantly excessive, with a few small areas having an imperfect to somewhat excessive internal drainage. This soil association is strongly to slightly acid in reaction.

160 Commerce-Robinsonville-Crevasse soils: This complex may contain two or more of the soils found in the Commerce, Robinsonville and Crevasse series. Most of the area is Commerce and Robinsonville, with small areas of Crevasse. The soils within this association are neutral to alkaline in reaction.

170 Crevasse soils: This complex of soils represents a very droughty and extremely sandy area. This complex of soils is the result of the flood of 1927 in this county. The topography is composed of small mounds, ridges and escarpments. The internal drainage is predominately excessive, with occasional small areas of imperfect to somewhat excessive internal drainage. The surface texture ranges from a very fine sandy loam to a loamy sand with by far the largest part being a fine sandy loam or loamy sand. The soils in this association are neutral to alkaline in reaction.

DOWLING SERIES

The Dowling series includes the very poorly drained alluvial soils derived from sediments of the Mississippi River. They occupy the "low swags" or depressional position. These soils are frequently covered by water and are slightly acid in reaction.

Soil types within the Dowling series:

210 Dowling soils
212 Dowling clay
213 Dowling silty clay
218 Dowling loamy sand (overwash condition

SOIL PROFILE: (212 Dowling clay) The surface of this soil is a dark gray clay, 2 to 3 inches deep. Just beneath the surface the subsoil begins and is a gray clay, mottled with shades of brown, 36 to 40 inches thick.

SOUVA SERIES

The Souva series includes the imperfectly drained alluvial soils derived from sediments of the Mississippi River and occupies the "low swags" or depressional areas. These soils accumulate water from higher ground and are frequently covered by water in the winter months. Slightly acid in reaction.

Soil types within the Souva series:

234 Souva silty clay loam
235 Souva silt loam
236 Souva very fine sandy loam

SOIL PROFILE: (235 Souva silt loam) The surface of this soil is a dark brownish gray friable silt loam 6 to 10 inches deep. The subsoil is a grayish brown, friable silty clay loam, mottled with shades of brown, yellow and gray,

Cotton fertilizer test on 312, Alligator clay. This test was conducted in 1947 and shows response of cotton to nitrogen. Very little response to commercial fertilizer other than nitrogen was found on this soil during this particular year.

15 to 20 inches thick. Beneath this, is a gray to grayish brown silty clay loam, mottled with shades of gray, yellow and brown. The profile is medium to slightly acid.

ALLIGATOR SERIES

The soils of the Alligator series include the very poorly drained alluvial soils derived from the light-colored, heavy textured, Mississippi River alluvium. They occur on the Low Bottom position and are locally called "buckshot" soils. They are found on level to sloping topography and generally occur east of U. S. Highway 61 in this county. The soil is usually medium to slightly acid in reaction.

Soil types within the Alligator series:

312 Alligator clay
313 Alligator silty clay
314 Alligator silty clay loam

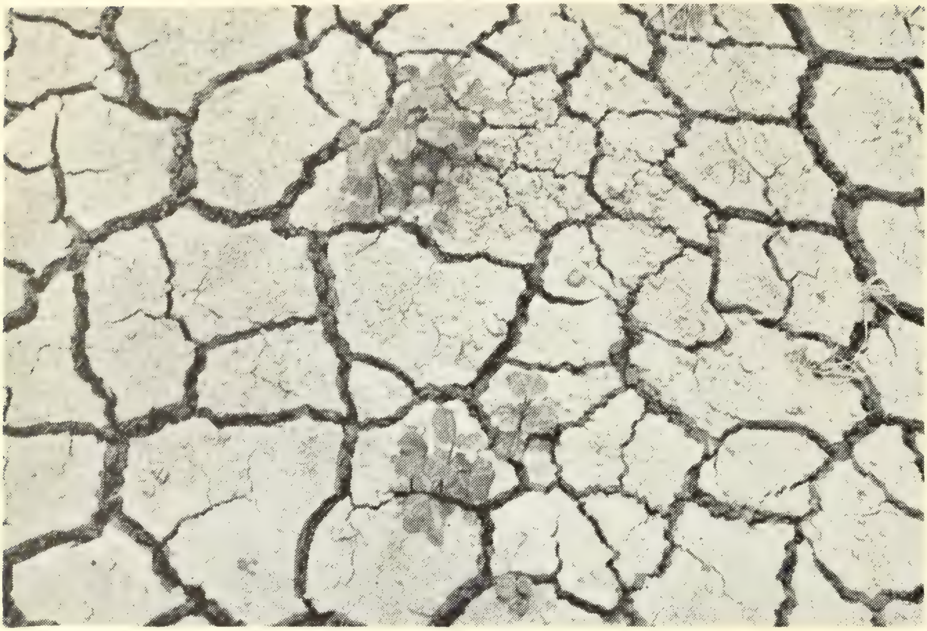
SOIL PROFILE: (312 Alligator clay) The surface of this soil is a firm light brownish-gray clay, strongly plastic when wet and very hard when dry, 2 to 6 inches deep. The subsoil is a mottled gray and yellow to light gray clay, slowly permeable to water. Other than surface texture Alligator silty clay and Alligator silty clay loam are essentially the same as Alligator clay.

SHARKEY SERIES

The soils of the Sharkey series include the poorly drained alluvial soils derived from the dark-colored, heavy textured Mississippi River alluvium. They occur in the Low Bottom position and are locally called "buckshot" soils. They differ from the Alligator soils in that the subsoil is much darker colored and less acid in reaction. They are found on level to undulating topography and are slightly acid to neutral in reaction. These soils comprise approximately 50 percent of the total land area of the county.

Soil types and phases within the Sharkey series:

322 Sharkey clay
323 Sharkey silty clay



This picture shows how heavy clay soils crack open in dry weather. The soil type here is 312, Alligator clay.

324 Sharkey silty clay loam

325+ Sharkey silty clay loam

325+ Sharkey silt loam (overwash condition)

326 Sharkey very fine sandy loam (overwash condition)

SOIL PROFILE: (322 Sharkey clay). The surface layer is a very firm dark grayish-brown clay; strongly plastic when wet, very hard when dry, 4 to 6 inches deep. The subsoil is a very dark gray to very dark grayish brown clay mottled with shades of gray and brown, slowly permeable to water. Other than a difference in surface texture, the other types are similar to Sharkey clay.

TUNICA SERIES

Soils of the Tunica series include the imperfectly drained alluvial soils derived from Mississippi River deposits. They resemble the Sharkey soils, with which they are closely associated, but differ from them in having sandy material at depths ranging from 18 inches to 25 inches. This sandy material causes the Tunica soils to be better drained than the Sharkey soils. The Tunica soils occupy the Low Bottom position and are found on gently undulating to sloping topography. They usually occupy relatively small areas, bordering streams and bayous in the slack water area. They are slightly acid to neutral in reaction.

Soil types within the Tunica series:

333 Tunica silty clay.

SOIL PROFILE: (333 Tunica silty clay) The surface of this soil is a dark grayish-brown, very firm silty clay, 3 to 4 inches deep. The subsoil is a firm dark gray to grayish brown clay, faintly mottled with shades of gray and brown, 10 to 20 inches thick. Beneath this, the texture becomes a sandy clay loam, mottled with yellowish red.

FORESTDALE SERIES

The soils of the Forestdale series are poorly drained alluvial soils, derived from medium to heavy textured sediments of the Mississippi River. These soils occur on the intermediate elevations of the old natural levee formations, known as the Low Terrace position. They are found on level to sloping topography. They are slightly to strongly acid in reaction.

Soil types within the Forestdale series:

423 Forestdale silty clay
424 Forestdale silty clay loam
425 Forestdale silt loam

SOIL PROFILE: (425 Forestdale silt loam). The surface of this soil is a light brownish gray friable silt loam, 4 to 6 inches deep. The subsoil just beneath is a grayish brown silty clay, mottled with shades of gray and brown, slowly permeable to water. This layer is from 6 to 25 inches deep. Below the second layer the soil is a light gray to gray silty clay loam, mottled with various shades of yellow and brown. Other than a difference in surface texture, Forestdale silty clay and Forestdale silty clay loam are essentially the same as Forestdale silt loam.

DUNDEE SERIES

The soils of the Dundee series are the imperfectly drained and derived from medium to light textured sediments of the Mississippi River. These soils are found on the intermediate elevations of the old natural levee formations and occupy the Low Terrace position. They have a significant amount of profile development and are slightly to strongly acid.

Soil types and phases within the Dundee series:

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1. **A plus sign indicates soil is underlain by clay, silty clay or silty clay loam at depths from 6 to 12 inches.**
2. **Underscoring the soil number one time indicates soil is underlain by clay or silty clay at depths from 12 to 24 inches.**
3. **Underscoring soil number two times, indicates soil is underlain by clay or silty clay at depths ranging from 24 to 48 inches.**

Wheat growing on 322, Sharkey clay. The yield here was approximately 45 bushels per acre.

Soybeans in rows growing on 322, Sharkey clay. The field of soybeans averaged approximately 40 bushels per acre.

433 Dundee silty clay
434 Dundee silty clay loam*
435 Dundee silt loam
436 Dundee very fine sandy loam

SOIL PROFILE: (435 Dundee silt loam). The surface of this soil is a light brownish gray friable silt loam 4 to 6 inches deep. The second layer is a light yellowish-brown silty clay, faintly mottled with shades of gray and yellow, slowly permeable to water. The third layer, beginning at about 25 inches deep, is a grayish-brown silty clay loam, mottled with shades of yellow and brown. This layer extends to about 35 inches; below that depth the soil becomes more sandy, ranging from a silty clay loam to a sandy loam. Other than a difference in surface texture the other types in this series are essentially the same as Dundee silt loam.

DUBBS SERIES

The soils of the Dubbs series are moderately well drained and derived from light textured Mississippi River alluvium. The soils occur on higher elevations of the old natural levees and occupy the Low Terrace position. They have a significant amount of profile development, and are medium to slightly acid.

Soil types within the Dubbs series:

444 Dubbs silty clay loam
445 Dubbs silt loam
446 Dubbs very fine sandy loam
447 Dubbs fine sandy loam

SOIL PROFILE: (446 Dubbs very fine sandy loam). The surface of this soil is a grayish-brown to dark brown, very friable, very fine sandy loam 4 to 8 inches deep. The second layer, from 8 to 20 inches deep, is a brown friable silty clay loam. The third layer, from 20 to 36 inches deep, is a light yellowish-brown, very friable, fine sandy loam. This profile has very few discolorations or mottles. Other than a difference in surface texture, the other soil types listed are essentially the same as Dubbs very fine sandy loam.

BOSKET SERIES

The soils of this series are well drained alluvial soils derived from light textured

Mississippi River alluvium. They occur on the higher elevations of old natural levee formations and are on the Low Terrace position. They occupy gently undulating to sloping topography, and are slightly to medium acid in reaction.

Soil types within the Bosket series:

454 Bosket silty clay loam
456 Bosket very fine loamy sand
457 Bosket fine sandy loam

SOIL PROFILE: (456 Bosket very fine sandy loam). The surface of this soil is a light brownish gray, very friable, very fine sandy loam 6 to 8 inches deep. The second layer, 8 to 24 inches deep, is a dark brown to brown friable sandy clay loam. The third layer, 24 to 36 inches deep is a yellowish-brown friable sandy loam. Other than a difference in surface texture the other types in this series are essentially the same as Bosket very fine sandy loam.

BEULAH SERIES

The Beulah series includes the somewhat excessively drained alluvial soils derived from light textured Mississippi River alluvium. In general, they occur on the higher elevations of old natural levee formations. They occupy the Low Terrace position and are found on gently undulating to undulating topography. They are medium to slightly acid in reaction.

Soil types within the Beulah series:

464 Beulah silty clay loam
466 Beulah very fine sandy loam
467 Beulah fine sandy loam
468 Beulah loamy sand

SOIL PROFILE: (466 Beulah very sandy loam). The surface of the soil is a light brownish gray, very friable, very fine sandy loam 6 to 8 inches deep. The second layer, 8 to 30 inches deep is a light yellowish-brown, very friable fine sandy loam. The third layer is a light yellowish-brown, very friable, fine sandy loam, 30 to 42 inches deep.

CLACK SERIES

The Clack soils include excessively

Cotton grows fairly well on 424, Forestdale silty clay loam. Under proper management one bale per acre can be expected over a five-year period. Large fields with long rows are well suited for mechanical harvesting.

Corn fertilizer test on 435, Dundee silt loam. This test was conducted in 1949 and picture shows response of corn to nitrogen. The four rows of corn in the center of the picture received no fertilizer whereas the surrounding corn received 120 pounds of nitrogen and varying rates of phosphorus and potassium. This particular test shows response to nitrogen only

drained alluvial soils derived from light textured Mississippi River alluvium. They occur on natural levees and occupy the Low Terrace position. They are found on undulating to gently undulating topography and are medium to strongly acid in reaction.

Soil types within the Clack series:

473 Clack silty clay
474 Clack silty clay loam
476 Clack very fine sandy loam
477 Clack fine sandy loam
478 Clack loamy sand

SOIL PROFILE: (478 Clack loamy sand). The surface of this soil is a loose, light yellowish-brown, loamy sand, 6 to 8 inches deep. Below that depth is a loose, very friable, yellowish brown, loamy sand. Other than a difference in surface texture the other types within this series are essentially the same as Clack loamy sand.

DYER SERIES

The Dyer series includes poorly drained alluvial soils. These soils have been formed from local alluvium washed from silty deposits in the Mississippi River floodplain. They occur in depressional positions and are generally wet during a large part of the year. They occur in small areas and are associated with the Dexter, Pearson and Brittain soils.

Soil types within the Dyer series:

T624 Dyer silty clay loam

SOIL PROFILE: The surface layer is a pale brown to a grayish-brown silty clay loam, 4 to 6 inches thick. Below this depth the subsoil is variable, usually being a mottled light gray, grayish brown or a pale brown silty clay loam or silty clay. The profile is medium to strongly acid throughout.

BRITTAIN SERIES

The soils of this series are poorly drained alluvial soils. They have developed from silty materials on stream terraces in association with the Dexter and Pearson soils. They occupy the Low Terrace position and are found on gently undulating topography.

Soil types within the Brittain series:

T825 Brittain silt loam

SOIL PROFILE: The first 9 inches of this soil is a grayish-brown, mellow, silt loam. The subsoil is a mottled gray and brown to light gray and yellow. silt loam down to approximately 20 inches deep. Below 20 inches is usually a layer of mottled silty clay loam, ranging in thickness from 10 to 20 inches. The profile is medium to slightly acid throughout.

PEARSON SERIES

The Pearson soils have been formed from silty alluvium on stream terraces. They occupy the Low Terrace position and are imperfectly drained silt loam and very fine sandy loam soils. They are found on gently undulating to sloping topography.

Soil types within the Pearson series:
T836 Pearson very fine sandy loam
T835 Pearson silt loam
T834 Pearson silty clay loam

SOIL PROFILE: The first 9 inches of this soil is usually a pale brown silt loam. From 9 to 20 inches this soil is a yellowish-brown silt loam, faintly mottled with shades of gray. From 20 to 40 inches this soil is a grayish-brown silty clay loam, mottled with yellowish-brown. (T835 Pearson silt loam).

DEXTER SERIES

The Dexter soils have formed from silty alluvium on stream terraces. They occupy the Low Terrace position and are moderately well drained. The surface texture is silt loam or very fine sandy loam. They are found on gently undulating to undulating topography. The entire profile is medium to slightly acid.

Soil types within the Dexter series:
T845 Dexter silt loam
T846 Dexter very fine sandy loam

Rice is produced on "buck shot" soil. This is a new use for Sharkey Clay No. 322 and similar clay soils.

SOIL PROFILE: (T845 Dexter silt loam). The surface of plow layer is a dark yellowish-brown friable silt loam 4 to 8 inches thick. Below that depth, the subsoil is a yellowish-brown to a reddish-brown silt loam, down to 20 inches. Below that the subsoil is a light silty clay loam to very fine sandy loam. Other than a difference in surface texture the Dexter very fine sandy loam is essentially the same as the Dexter silt loam.

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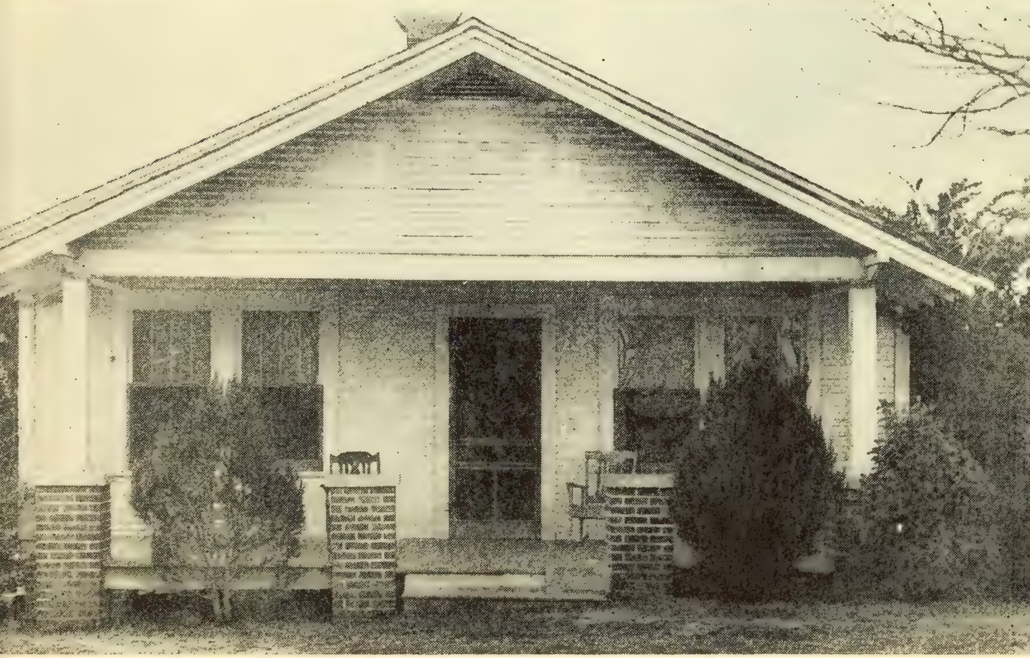
BULLETIN 490 MARCH, 1952

HOUSING OF FARM-OWNER-OPERATOR FAMILIES IN THE MISSISSIPPI LOWER COASTAL AREA



MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
CLAY LYLE, Director
STATE COLLEGE MISSISSIPPI

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DESIGNING FAMILY DWELLINGS FOR THE MISSISSIPPI LOWER COASTAL AREA

From the study of housing facilities, preferences, and of activities that go on in houses of farm-owner-operator families in the Mississippi Lower Coastal Area, there seem to be three problems for special concern to the designer of farm dwellings. The first two relate particularly to new houses and the third to improvements of old houses. These problems are: (1) Kinds and type of room combinations (2) Space requirements (3) Improvements that can be made in design on farm dwellings we now have.

Since housing needs of families change and different families use the same house, flexibility should be the keynote of house design. This study shows that an adequate house plan would include (a) a living room (b) a dining room (c) a dining area in the kitchen (d) a bathroom (e) bedrooms including a guest room (f) closets in every room and a pantry in the kitchen (g) front and back porches (h) utility room.

At a minimum level of planning the following kinds and types of room combinations seem important:

(a) A living room with sleeping facilities for guests and/or family members.

(b) In houses of five or more rooms it would be important to have one room that can be used either as a bedroom or as a dining room. (This does not mean that a particular family would use the same room for both purposes at a given time, but for these two purposes at different times as the family changes. The bedroom-dining room is not a combination families in this area make).

(c) A bathroom without water piped in or the conventional fixtures, located so men can "wash up" without going through the kitchen or living areas of the house. Having a bathroom makes for efficient placing of equipment for the activity, for privacy, and as a stimulus to plan for getting water piped in and modern facilities.

(d) Closets in every room. It is important that there be closets even though funds are not sufficient to purchase doors to these closets.

(e) A dining area in the kitchen and an area for dining on the back porch.

(f) A back screened porch so constructed that it is suitable the year around to use as a utility room. (Most families in the area do not want glassed-in or enclosed porches.)

(g) A front porch, open.

It is important that this house be planned so that it can be easily added to as the family changes or different families move in.

Data on kind and number of possessions to be stored in the house (such as bedding and household textiles, dishes and glassware, silver and table appliances, kitchen utensils and equipment, canned foods and empty jars, other foods of all kinds, and clothing) were obtained and for purposes of analysis were summarized at two different planning levels; the minimum, a space to accommodate 50 per cent of the families and the adequate, a level to accommodate 75 per cent of them. These data have been mimeographed and may be obtained from the Home Economics Department of the Mississippi Agricultural Experiment Station.

Space requirements for some of the larger household equipment and furniture at the two levels of planning included:

	Accommodate 50% of the families	Accommodate 75% of the families
Refrigerator (Size)	6 cu. ft.	7 cu. ft.
Washing machine (No.)	0	1
Sewing machine (No.)	1	1
Rocking and/or arm chairs (No.)	3	4
Combinations of large furniture (davenports, pianos, desks, buffets) No. pieces	1	2
Radios (No.)	1	1

Number of people for which space must be provided for specified activities carried on in the family dwelling were likewise determined. Among these were:

	Accommodate 50% of the families	Accommodate 75% of the families
No. persons for whom seating space desired in dining room	8	8
No. persons who work in kitchen at one time	1	2
No. overnight guests at one time	2	3
No. persons at club meetings or other get-togethers	0	14

Work loads such as amount of fruits and vegetables generally canned in one day during past year; usual number of garments of specified kinds to launder in summer and in winter, are types of information helpful in estimating space needed for such activities. Space needed to accommodate work loads of 50 per cent and of 75 per cent of the families (at minimum and adequate levels of planning) was for example:

	Accommodate 50% of the families	Accommodate 75% of the families
Work Loads at one Time		
Vegetables and fruits canned (No. qts.)	14	14
Sheets and tablecloths washed, summer (No.)	6	8
Towels, washed, summer (No.)	10	14
Garments washed, summer (No.)	21	37

From this study it would seem that there might be four emphases in plans for remodeling. These are: (a) inexpensive and practical methods of adding closets to each room. It is impossible to have an efficient and attractive house without good storage. The addition of closets often involves the problem of space. One method of conserving space is by the addition of sliding doors rather than doors that open out in the room. (b) Good suggestions for adding a bathroom in houses built without such a room. What are the plans of those families who seem to have worked out a successful solution to this big problem? Two such plans are shown. (See figure 3.) (c) Remodeling the back porch so that it will be suitable for a family work center. (d) Planning a family recreational center either on the back porch or in some other area at the back. There are a growing number of families interested in such a facility.

Housing of Farm-Owner-Operator Families In The Mississippi Lower Coastal Area

By DOROTHY DICKINS

This bulletin reports the results of a survey made in the Mississippi Lower Coastal Area of farm-owner-operator families' preferences, possessions and activities as they relate to housing needs. The survey is part of a cooperative regional project by the Agricultural Experiment Stations in seven Southern states and the Bureau of Human Nutrition and Home Economics of the United States Department of Agriculture.

This particular report includes the 90 families in the regional sample and an additional 71. These 161 farm families were drawn to represent owner-operator families in the Lower Coastal Area of the State (see figure 1.)

The objectives of the study were twofold: (1) to learn the characteristics of farm dwellings in the Lower Coastal Area of the State and (2) to find out the activities and attitudes affecting housing requirements.

Such a study, it was thought, would contribute not only to improvement of designs for new homes, but to the solution of problems incident to remodeling, to the installation of new facilities and equipment, and to better use of facilities which present farm dwellings offer.

These farm families need advice and the people from whom they will get it—architects, engineers, builders, contractors, lumber dealers and educators—need to know more than has been known about the kind of houses such farm families need and want.

SCOPE AND METHODS OF THE STUDY

Jones, Pearl River and Simpson Counties were selected for the study by the Institute of Statistics of North Carolina State College to represent the Mississippi Lower Coastal Area. A total of 29 master sample areas in these three counties was drawn. The 337 families residing in the areas were visited during May and June, 1948, by trained interviewers to determine eligibility for study. To be eligible for the study the family must have owned all or part of its farm and operated the farm; and the household had to consist of two or more members, one of whom was a homemaker at least 16 years of age related to the operator or herself the operator.

Homemakers in families found to be eligible were interviewed with the use of the family schedule. There were 163 eligible families and schedules were completed for 161. The schedule used contained questions about the characteristics of the family, of the dwelling unit it occupied, and of the farm as well as about household activities and preferences for specified characteristics in a new farm house.

In addition to the family schedule, there was a brief schedule (the community schedule) for recording information about local factors affecting design and construction of farm houses. One of these was filled out for each of the three counties. The information was obtained from interviews with agricultural and home extension agents, health officials, weather station officials and others familiar with the area.

CHARACTERISTICS OF THE FAMILIES

This study was limited to owner operator families since owners are directly concerned with the problem of building and remodeling their family dwellings. Then, too, the majority of farm operators in the Lower Coastal Area of the State are owner families, usually white owner families. In the sample of 161 families there were only 10 Negro families.

One hundred and fifty of the 161 families were normal families; that is, had both husband and wife. Fifty-two per cent of the families had two, three, or four members, the remainder had

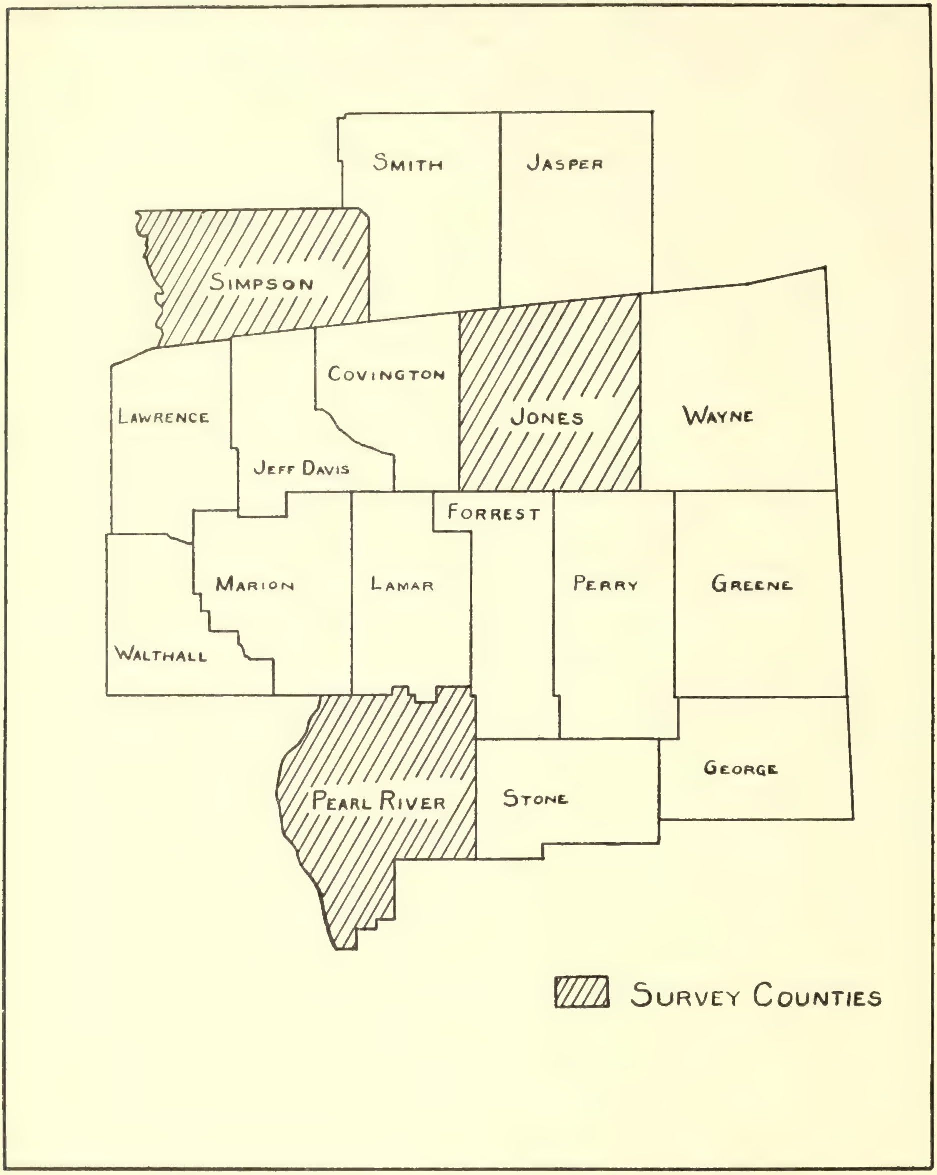
Smith
Jasper
Simpson
Covington
Lawrence
Jones
Wayne
Jeff Davis
Forrest
Marion
Lamar
Perry
Greene
Walthall
Pearl River
Stone
George
▨ Survey Counties

FIGURE 1. Map showing counties in the Mississippi Lower Coastal Area and counties included in the survey.

five or more members. Fifty-five per cent of the families had one or more children under 12 years of age; seventy-one per cent had one or more 18 years and under. Only 29 per cent of the families had adult members only. These adult families were mainly older families.

Socioeconomic ratings (or scores obtained by the use of the Short Form of Sewell's Farm Family Socioeconomic Status Scale which bases scores on ownership of certain material possessions, and on social participation of family head and his wife) were used for classifying families. It was thought that such a rating would be more appropriate for classification of families in a study of housing than would current net income.

The 161 families in this study fell into about the same socioeconomic rating patterns as did the 1507 families included in the Southern regional study. Fifty-five per cent of the group had scores of 39-69 and 45 per cent had scores of 70-91. Socioeconomic ratings of these 161 owner-operator families were somewhat higher than ratings by the same scale of owner-operator families included in the Mississippi Delta Cotton sample of the Southern Family Food Consumption project, a study made about the same time as the Southern housing study. Sixty-eight per cent of the Delta Cotton owner-operator families had scores of less than 70. Since socioeconomic ratings of all farm families in the State are being raised, housing data from a group of families with somewhat higher socioeconomic rating should be especially useful as a basis for development of functional farm house plans.

SOURCE OF FAMILY INCOME

In the area selected for study, farming was by and large a mode of living rather than the method of getting a living. Eighty-two per cent of the 164 families ineligible for the study were ineligible because they did not live on a farm.[1] Of those who were included in the study, that is, lived on a farm, only 17 per cent said they did not have any income besides that from selling farm products.

There was only one important source for this other income reported. This source was from work off the farm. Seventy-one per cent of the 161 families reported income from off-farm work. Other sources mentioned in order of importance were veteran's benefits, money from married children living away from home, public assistance pensions, handicrafts, boarders and roomers, insurance and annuities.

The off-farm work which members in these families had varied between counties as well as between families. In Jones County off-farm work was more often work in town since Laurel, the county seat, is a highly industrialized city and provides much work to rural residents. In Pearl River County, the most important off-farm work reported was in connection with the tung orchards. In Simpson County sawmilling, stump digging, and trucking drew upon the farming population.

Preferences, possessions, and activities as they relate to housing needs would, of course, depend in part on whether the homemaker worked off the farm. In this study relatively few (7 per cent) did. Persons in the 161 families working off the farm were as follows:

Head only	46%
None	29%
One other member	9%
One other member and head	6%
Homemaker only	4%
All other combinations	6%

Almost two-thirds (59 per cent) of the farms operated by families in the study group were family living farms. By family living farms is meant that the farm products produced for home use were worth more than those produced for sale. More cotton farms than any other type were found among units producing primarily for sale.

THE FARM HOUSES

A Description

A brief description of the houses occupied by the 161 families in the study is given (1) to provide a basis for analyzing the opinions and preferences expressed by homemakers (2) to give the reader a general picture of farm houses in the area of the study (3) to provide information that may prove helpful in house remodeling programs.

Two-thirds of the family dwellings had been built by the occupants. "Built by" means the occupants had had the house built, or had assisted or built it. Homemakers were not questioned concerning work done by family members but from the "community schedule" previously referred to, it was learned that rough carpentry work in connection with home building is ordinarily done by family members. Finished carpentry, cabinet building and chimney building, it was reported, is done by some farm families. Two-thirds of the houses had been built since World War I.

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[1] A farm was defined as a tract of land on which some agricultural activities were carried on, and which consisted of three acres or more of land, or produced during the preceding year products valued at $450 or more.

Most of the houses were of frame construction as shown by the following summary:

Painted frame	47%
Unpainted frame	39%
Composition or asbestos siding	7%
Asbestos-cement siding, brick and other	7%

In this study, houses in which the paint was checked or indistinct were classified as unpainted. The large proportion of unpainted frame houses is in part due to high upkeep cost of a painted house in the Lower Coastal Area where there is rainfall about 100 days during the year and where average maximum temperature in the summer months is around 90° and average minimum temperature in winter months about 40°.

One hundred and fifty-seven of the 161 houses had only one story. Two of the 161 houses had a basement or cellar and three an attic. In the Lower Coastal Area ground water and soil conditions are unfavorable to basement construction. For a great part of the year attics are too hot for family living activities unless ventilated or air cooled. These processes are costly.

More families had 5-room houses than any other size. Median size of the house (the size that marks the dividing line between the upper and lower halves of the distribution of houses by size) was also 5 rooms. Six-room units were only slightly less numerous than five-room ones. These two sizes made up 65 per cent of the total. Number of rooms lived in corresponded very closely with number of rooms in the house.

A recognized problem in housing is that of designing houses that will meet the needs of the family in each of its various stages. The need for space is usually greatest at the period when there are teen-age children, for then the number of members is likely to be largest and the activities most varied. In this study 41 per cent of the families with children in the teens had houses with less than one room per person. Only two per cent of the adult families were as crowded. The standard for crowding frequently used is less space than one room per person.

Kinds of rooms. Homemakers were asked to name the rooms in their houses. Rooms were listed as they reported them. For instance, if the homemaker called a room a "bedroom" which the interviewer regarded as a living room, she was instructed to record the room as a bedroom. Only rooms partitioned off from floor to ceiling were counted. Thus, a dinette separated from the kitchen by a cabinet or a partition that did not reach the ceiling was not listed as a separate room.

Information about the kinds of rooms in the houses by family size is given in table 1. As will be noted, the main difference in kinds of rooms in houses of smaller and larger families was that larger families had more rooms which they reported as bedrooms, fewer as living and dining rooms, than did smaller families. Breakfast rooms were reported only by families also reporting dining rooms.

Table 1. Percentage of families having specified kinds of rooms classified by family size.

Kinds of Rooms	Family size		
	2 - 4 members	5 members & over	All families
	Per cent	Per cent	Per cent
Kitchen	100	100	100
Living room	66	58	62
Dining room	75	69	71
Breakfast room	4	3	4
Bedrooms:			
1	4	4	4
2	46	24	35
3	42	51	47
4 and over	8	21	14
Halls	10	8	9
Other rooms*	4	1	3
Number families	83	78	161
Median socio-economic score of families	68	67	68
Average size of house (No. rooms)	5.2	5.4	5.3

*Two dens and two utility rooms.

A big hall through the center of the house serving as a family summer sitting room is a traditional style of many of the older homes of the State. In this study such a room was relatively unimportant.

In the study concerned with house design, the proportion of families having various kinds of rooms is important, but even more important is the combination of rooms families actually made. Shown below are the most common combinations of rooms for houses of specified size:

	Percentage of families having
4-room house	
3 bedrooms, kitchen	38
2 bedrooms, living room, kitchen	31
2 bedrooms, dining room, kitchen	28
5-room house	
2 bedrooms, living room, dining room, kitchen	54
3 bedrooms, dining room, kitchen	31
3 bedrooms, living room, kitchen	12
6-room house	
3 bedrooms, living room, dining room, kitchen	77
4 bedrooms, dining room, kitchen	19
7-room house	
4 bedrooms, living room, dining room, kitchen	90

As size of house increased, more families had both dining and living rooms. Only one per cent of the families with 4-room houses made the combination of one bedroom, living room, dining room and kitchen. But as will be noted, 54 per cent in 5-room houses, 77 per cent in 6-room houses and 90 per cent in 7-room houses had both living and dining rooms.

Houses of larger families less often had both a living room and a dining room. (Fifty-four per cent of the smaller families and 44 per cent of the larger families had both). But when families in both groups had one of these rooms, they more frequently had a dining room than a living room.

Porches. Porches were most important in this Lower Coastal Area. Ninety-two per cent of the families had one or more. Porches were defined as areas with both a floor and a roof. Stoops or platforms that served mainly as entrances were not regarded as porches. Glassed-in porches were regarded as rooms, not porches. Porches in this study were either open or screened.

Questions concerning whether the porch was screened or open were not included in the schedule of this study. But the majority of the interviewers wrote in this information on the schedules they filled out. From these, it would seem that most of the porches were open, especially front porches. Many of the back porches, however, were reported as screened.

The front porch was by and large the most important type of porch. Eighty-nine per cent of the family dwellings had front porches, 55 per cent back porches and 4 per cent side porches. Two-porch houses (usually front and back porch) were most common. Fifty-five per cent of the families had two-porch houses, 36 per cent one-porch houses, and one per cent three-porch houses.

Storage facilities. Thirty per cent of the houses of families in this study had none of the storage facilities listed below. The percentage of families having these facilities was as follows:

Clothes closets	57%
1 closet	26%
2 or more closets	31%
Other closets	10%
Store rooms	8%
Pantries	29%
Attics	2%
Basements	1%

One clothes closet (called a "locker" by many families in the area) for each bedroom is usually considered a minimum desirable standard for space for clothing storage. One-fifth of the houses of families in this study met this standard. Although it might be expected that the newer houses would be better planned with respect to storage than the older, this was not the case. The older houses had clothes closets as frequently as the new ones, and more of them had "store rooms." The store room was often a room originally used as a bedroom but not needed for that purpose by the family occupying the house.

Homemakers were asked during the interview how they used the rooms, halls, and porches they had. A list of possible uses for each of these areas was attached to the schedules to aid interviewers in questioning. This list, except for halls did not specify storage, but storage was often mentioned when homemakers were asked about "any other uses." Most homemakers stated that they used the back porch to hang work coats and hats. Many reported the back porch as a place to store wood. Storage was rarely mentioned in connection with the front porch.

Housing Preferences and Opinions

Outside area, style, stories. There were only a few questions in the schedule related to the outside area. One concerned the entrance of the house desired for callers. Complaints from many farm homemakers had been heard of callers entering the house from the back, and it seemed desirable to get information on this point.

Eighty-six per cent of the 161 homemakers interviewed said they wanted callers to enter the front door into a living room or front hall. Only two homemakers were satisfied to have them come in through the back door, through the kitchen. The remaining usually mentioned a side porch leading into a living room. The women preferred, however, that members of the family coming from town or church enter the back door, as evidenced by their reply as to the best place for a closet to hang coats worn to town or church. The majority of them replied: "Near the back door."

Most homemakers did not think it essential for the front door to open into a hall or vestibule. This opinion can probably be explained by the mild climate, and the fact that the front entrance would be used mostly for company. Furthermore, and perhaps more important, houses in the area usually do not have entrance halls.

When asked about the view desired from the kitchen window, another question relating to the outside area, the majority of women mentioned something in connection with the farm such as farm buildings, farm road, crops. It may be that since many of their husbands had gainful work away from home that they had more than usual responsibility in keeping in touch with the farm activities. On the other hand, most farmers' wives play an important part in operation of the farm when their husbands are engaged full time in farming.

Two questions were included concerning style of the house: (1) Is there any particular style of architecture that you would choose if you were building a new house; if so, what? (2) What do you think of the modern style of house with flat roof? Only 41 women named or described the style of architecture they would choose if building a new house. Twenty-nine of these said bungalow, 6 ranch, 2 Cape Cod, 2 modern, 1 Spanish, and 1 Colonial. It seems significant that the style characterized by a wide veranda should have been mentioned as often.

When homemakers were asked to express an opinion of a style with a flat roof, they were much more verbal. About two-thirds expressed an unfavorable opinion. Comments made by the women were often written on the schedule and included "Too low and hot," "Much too hot."

The popularity of the one-story house has already been indicated. Only 4 of the families had houses of more than one story. Only 11 (or 7 per cent) of the homemakers stated that if they were building a house and could plan it as they wanted it that they would have two-story houses.

Windows. Homemakers were asked about the desirability of a window over the kitchen sink and of low windows in the living room so the children can look out. All except three women stated they would not build a house without a window over the kitchen sink.

Sixty-one per cent of the women with one or more children under 9 years of age said they would consider some low windows in the living room a necessary feature of new houses. Although families of other types were not quite so conscious of a need for this feature, 40 per cent of the adult families and of families with older children said they would want to include low windows if they were building. Low windows make it possible for the young child to look out without climbing up or being lifted.

Rooms. The homemakers were not

asked how many rooms they would want in a new house. It was assumed that the size of house a family selected for building would be determined largely by the number of people to be housed and the amount the family could invest in a house.

Facts about the houses occupied by the 161 families give some indication of the sizes of houses in which they were most interested. As previously stated, two-thirds of the families lived in 5 or 6 room houses. There was a slight trend for houses built before 1940 to be somewhat larger than those built since 1940. Thirty-three per cent of those built since 1940 had 6 or more rooms, while of those built before 1940, 41 per cent had 6 or more rooms. Possibly increasing building costs as well as decreasing family size are factors in this trend.

Since plans for small houses are likely to be in demand, it seemed worthwhile to consider what room combination may make the most satisfactory small-house arrangements. Every homemaker interviewed was asked: If a family of father, mother, and two boys and a girl of school age were planning to build a four-room house, what rooms do you think would be best for them? Two-thirds of the women replied: "Kitchen and three bedrooms."

When asked: Now, if this same family of five were planning a five-room house, what rooms do you think would be best? 70 per cent replied: "Three bed-rooms kitchen and living room." It is interesting to note that homemakers did not give the dining room for this imaginary family the importance that it seemed to be given in their own house plans.

As a further indication of the relative value placed upon different rooms in the small house, each homemaker living in a house of four rooms or less was asked what room she would add first, and what room second, if her house were to be enlarged. An additional bedroom seemed most important. Next in importance was a living room.

Porches. The opinions expressed by the families interviewed show that porches should continue to be an important feature of farm houses in the area studied (figure 2). The climate of the Lower Coastal Area makes porches desirable areas for both work and recreation. The temperature is such that porches may be used most of the year. Glassed-in or enclosed porches are not wanted, except by a few women in the higher socioeconomic group who want a glassed-in side porch.

When homemakers were asked to imagine they were planning to build a new house and could have it as they wanted it, practically all said they would have both back and front porch. Of those saying they would have a front porch, 58 per cent said screened; 36 per cent open; and 6 per cent glassed-in or enclosed. Of those saying they would have a back porch, 90 per cent said screened; 5 per cent open and 5 per cent glassed-in or enclosed. Of those saying they would have a side porch, 41 per cent said screened; 15 per cent open; and 44 per cent glassed-in or enclosed. Family activities that took place on these porches are to be discussed in another section of the report.

Storage facilities. Homemakers in this study were not asked about the kind and amount of storage space desired since it was assumed that storage facilities should be based on kinds and amounts of possessions to store. Amounts of possessions which families of this study had to store have been classified at two planning levels and have been mimeographed. These may be obtained from the Home Economics Department of the Mississippi Agricultural Experiment Station.

In the General Housing Preference Section, as well as in other sections of the schedule, there were several questions that led homemakers to express preferences and opinions concerning storage. At the end of the General Housing Preference Section was one question that provoked many comments on storage facilities. It was: Now can you think of any other features that are so important to you that you wouldn't like to build a house without them? Seventy-one per cent of the 167 comments pertained to storage facilities.

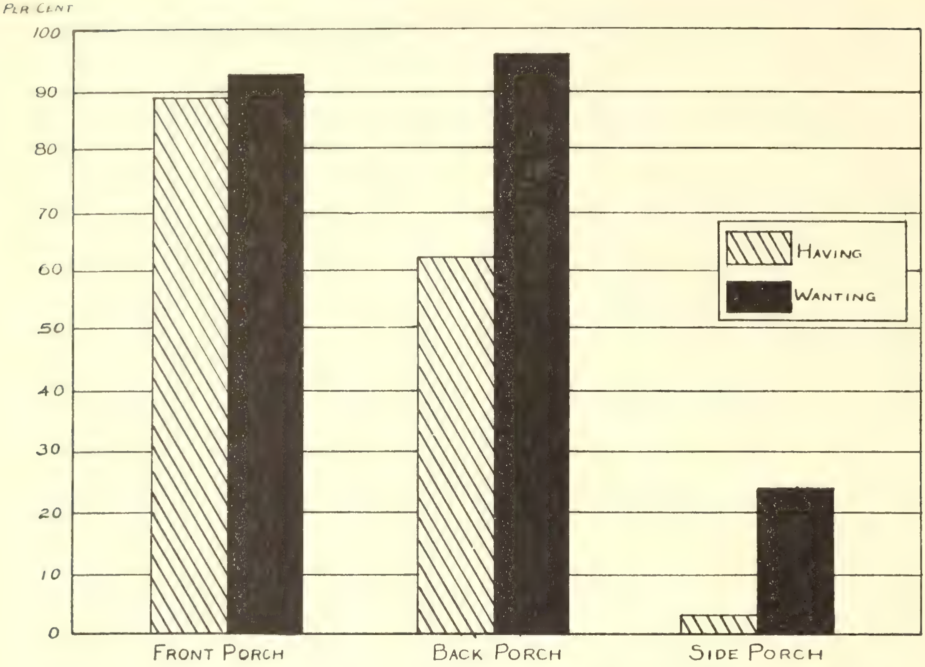

FIGURE 2. Percentage of families having and wanting porches of specified kinds.

As has been previously stated only two of the 161 houses had cellars or basements. Yet, one-sixth of the women interviewed stated that they thought a basement so necessary they wouldn't want to build without one, and about this same percentage stated that the basement was the best place to store canned food. No doubt the women were thinking of some cool place in the house to store their food. The most common place for storing canned food was in an area not in the house ("smoke house," "bank," "crib," "fruit house").[2] It was interesting to note, however, that only about 10 per cent thought this the best place. Sixty per cent thought a pantry in the house and 18 per cent a cellar or basement was the best place to store such food. No doubt the pantry would have to be ventilated to meet the satisfaction of the majority.

In the question, would or wouldn't you want porches on the house and what would you use them for, homemakers mentioned family activities rather than storage.

HOUSING FACILITIES, FURNITURE AND EQUIPMENT RELATING TO DESIGN

Electricity, Water and Telephones

One question on the community schedule asked was: What changes that may affect farm housing needs are taking place in the community? In all three counties availability of electric power was mentioned. All stated that electric power lines were rapidly spreading through the rural areas. Almost three-fourths of the 161 families had electricity in their houses. Running water in the house, dependent largely upon electricity, was not owned by nearly as many families. Only 43 per cent had water piped into their house.

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[2] **Smokehouse**—a place for curing meats, also used for food storage. **Bank**—a pit dug in the side of a dirt hill for vegetable storage. **Crib**—an outbuilding used for storage, generally feed, but occasionally for foods. **Fruit house**—an outbuilding used for food storage, may store canned or dried foods—usually no meat if designated by this term.

Still fewer families had what is defined in this study as a complete bathroom; a room with running water and the three conventional fixtures—water closet, lavatory, and bath tub or shower. Only 15 per cent of the families had one. There were in addition three per cent more who had a lavatory complete; that is, a lavatory with running water and two conventional fixtures, water closet, and lavatory.

Only eight per cent of the families had a telephone. It was after this study that the President of the United States signed a bill that made available funds through the Rural Electric Administration for telephone lines.

Heating

In this study there were a number of questions included in the schedule about heating since it was thought that places for household activities and in turn preferences might be based on practices in respect to heating. For example: one does this activity in the bedroom because the bedroom is heated regularly. Homemakers were asked to name the rooms heated regularly during winter.

The most frequent replies to the question: Rooms heated regularly in winter were:

	Per cent reporting
One bedroom and kitchen	39 (48)
Kitchen and living room	16 (12)
One bedroom and dining room	15 (14)
Two bedrooms and kitchen	9 (1)
Kitchen only	4 (1)
All rooms	3 (6)

To the right in brackets is shown the per cent of homemakers naming rooms of specified kinds they would want to heat regularly in a new house. As will be noted, homemakers seemed on the whole fairly satisfied with present practices as to room heating. The majority wanted at least one bedroom heated regularly plus some other room, usually the kitchen. In fact, 85 per cent of the homemakers said they wanted one bedroom heated regularly, but only 50 per cent thought that this room must be the parents' bedroom.

Houses were heated practically altogether with fireplaces, unit heaters and/or the cook stove. Seventy per cent of the houses in the sample were heated in part, at least, by fireplaces. The mild climate makes a small amount of heat sufficient to warm the house during much of the short cool season.

The most common types of heating unit combinations were:

Fireplace and cook stove	53%
Unit heater and cook stove	21%
Unit heater, cook stove and fireplace	8%
Unit heater and fireplace	7%
Unit heater only	6%

More than three-fourths of the families used wood wholly or in part for heating. Gas was of next importance (about one-third of the families used it). The heating done with wood was usually by means of fireplaces or the cook stove while with gas it was usually by means of small unit heaters or the cook stove. Forty-seven per cent of the 161 families used wood only, 17 per cent gas only, 17 per cent both wood and kerosene or oil, and 12 per cent both wood and gas. Electricity was relatively unimportant. Only 5 of the 161 families reported its use for heating.

In the Housing Preferences Section homemakers were asked: What kind of fuel do you think would be best for the main heating of new houses in this community? About 8 out of every 10 women replied: "Gas." About 2 out of every 3 of the women thought the best kind of heating equipment for gas was the small-unit room heater. The others mentioned circulating heaters and floor furnaces. Only a few mentioned floor furnaces. The floor furnaces heat more efficiently than the unit heaters, but few women wanted all their house, or even a large part of it, heated at one time.

That these Mississippi farm homemakers did not want to give up the fireplace altogether is evidenced by the fact that 71 per cent of the women said they thought a fireplace so important for a living room that they would not want to build a house without this feature.

Furniture

Information about patterns of ownership of furniture and equipment was obtained for use as a guide to planning space. It was evident that these patterns were undergoing changes due to relatively high incomes of farm families at the time of the survey, and to rapidly increasing farm electrification. Therefore, homemakers were questioned about plans for purchase within two years as well as about present ownership.

For the purpose of analysis, it was decided that the data might provide a basis for house planning at two different levels. Up to 50 per cent of the families would determine what would be provided for at the minimum level of planning; up to 75 per cent would be provided for at the adequate level. Below is a summary of space needs by specified items and furniture at these two levels to accommodate families at time of interview and after planned purchases.

	To accommodate 50% of the families		To accommodate 75% of the families	
	At time of interview	After planned purchases	At time of interview	After planned purchases
Rocking chairs and/or armchairs (No.)	3	4	4	5
Combinations of large furniture (davenports, pianos, desks, buffets) (No.)	1	2	2	3
Dining tables (No.)	1	1	1	1
Radios (No.)	1	1	1	1

Equipment

Refrigerators and home - freezers. Space for a refrigerator would be needed both at the adequate and minimum levels of planning. A little more than three-fourths of the families (78 per cent) had a refrigerator. Mechanical refrigerators were owned somewhat more frequently than ice refrigerators. Of those families with refrigerators, 51 per cent had electric, 43 per cent ice, and 6 per cent gas or kerosene.

Space for a six-cubic-foot box would accommodate 50 per cent of the families; space for a seven-cubic-foot box would accommodate 75 per cent of them. At both levels of planning, however, it would seem that somewhat more space should be allowed since there are two kinds of trends that are likely to result in use of larger refrigerators. The first of these is the trend from the ice to the mechanical refrigerator. Nine per cent of the mechanical refrigerators were 5 cubic feet or less, while 46 per cent of the ice refrigerators were as small. There was evidence from comments made by homemakers written on schedules by interviewers that some of the women regarded their ice refrigerators as a make-shift to use until a mechanical one could be afforded.

Homemakers of this study were not asked if they were planning to buy a refrigerator in the next two years. Data were obtained, however, from 73 of the homemakers 35 years and over concerning kind of refrigerator owned in 1935. In 1935 only three per cent of these women reported owning a mechancial refrigerator while at the time of the study 52 per cent of these same women had one. If this trend of increased ownership of mechanical refrigerators continues in the 13 years following 1948 as it did in the 13 years following 1935, by 1961 there will be few, if any, owner-operator families without a mechanical refrigerator.

With increased ownership of mechanical refrigerators homemakers will doubtless store an increasing amount of perishable foods in a refrigerated area. At the present time much perishable food especially in the winter months is not kept in a refrigerated area. (table 2)

Three factors lead to storage in unrefrigerated areas: (1) not owning a refrigerator (2) owning an ice refrigerator, but purchasing ice during summer months only. (There are many mild days throughout the winter; therefore, perishable foods need to be kept in a refrigerated area winter as well as summer.) (3) the custom of keeping perishables in other places than a re-

Table 2. Places where families keep perishable foods during winter and summer.

Places where kept	Perishable foods:									
	Butter		Eggs		Meat		Milk		Left-over food	
	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
Refrigerated area	57	76	36	58	55	74	57	77	45	64
Unrefrigerated area in kitchen	38	19	52	28	25	12	37	16	52	34
Unrefrigerated area in other part of home	1	1	10	9	0	0	2	2	2	1
Dairy or outside house	4	4	1	3	8	5	4	4	0	0
Other	0	0	1	1	0	0	0	1	0	0
Do not keep	0	0	0	1	12	9	0	0	1	1
TOTAL	100	100	100	100	100	100	100	100	100	100

frigerated area, a custom passed down from the period when refrigeration was not available. Only 10 per cent of the women having mechanical refrigerators when asked if they thought their refrigerator large enough replied: "No." Yet some of the women satisfied with the size of their mechanical refrigerator stored leftover food in an unrefrigerated area. As homemakers learn more about use of refrigeration, there will doubtless be a demand for refrigerators of larger size.

Only three of the 161 homemakers reported ownership of a home-freezer. Plans to buy a home-freezer within two years were reported, however, by 16 of the women. If these plans were carried out 12 per cent of the 161 homes would be equipped with a freezer. This means that space will not be needed either at the minimum or the adequate level of planning for a home-freezer, at least for some time to come.

Ranges. A range was defined in this study as a cooking stove with three or more top burners or a cooking surface and a built-in oven. All families, except one, had a range as thus defined. This family used a small heater for cooking.

Wood or coal ranges were in use in kitchens of a little more than one-half the 161 families, and gas and kerosene ranges each in about one-fourth the kitchens. The following summary of present and expected ownership shows a trend toward the gas range.

Kinds of ranges	Per cent of 161 families owning	
	At time of interview	After purchase as planned
Wood and/or coal	42	29
Gas only	27	39
Kerosene only	17	11
Kerosene and wood and/or coal	9	10
Electric only	3	7
Other combinations of 2 ranges	1	3
No range	1	1

Thirty per cent of the women said they planned to buy another range within the next two years. One-sixth of these expected to buy the same kind of range they were using. The remainder planned to choose a range utilizing fuel different from that in current use. The most frequent change planned was to replace the wood and/or coal range for a gas one.

It would seem that in house plans for families in the Mississippi Lower Coastal Area, that a place to store fire wood will not be an important consideration.

Laundry equipment. Space for a mechanical washing machine will be needed both at the adequate and the minimum level of planning when intentions to buy in the next two years are carried out as is shown:

	Per cent of 161 families owning	
	At time of interview	After purchase as planned
Washing machine		
Electric non-automatic	24	48
Electric automatic	2	9
Electric irons		
Hand irons	70	79
Ironers	2	2

Space for an ironer will not be necessary at minimum or adequate levels of planning. At both levels space for storing an electric hand iron will meet the needs of the families.

The opinions of the homemakers about built-in (stationary) laundry tubs and built-in ironing boards was obtained. In general, the women preferred both tubs and ironing boards that they could move about. These were the kind with which they were most familiar. (Only one per cent had stationary tubs; only two per cent built-in ironing boards). It seems significant, however, that even though homemakers in this study were unfamiliar with built-in equipment, a little more than one-third said that they would want set tubs and a built-in ironing board.

Sewing Machine

At both the adequate and minimum level of planning there should be space provided for a sewing machine. (Seventy-six per cent of the 161 families had sewing machines and 97 per cent of the machines owned were of the treadle type.) At neither level of planning would it be necessary to provide space for an "open" machine, for homemakers in this study did not think they sewed sufficiently to want the machine ready to use at all times.

ACTIVITIES IN THE HOME

Family and Company Sleeping

As the number of bedrooms in the house increased, these rooms were less likely to be used as a place for members of the family to sleep and more likely to be used for guests only (table 3). The most common methods of accommodating overnight guests were: (1) in a guest room (or rooms), (2) family members double up, children move in with parents or parents with children and give room or rooms to guests, (3) guests stay in the bedroom with family members, (4) guests used day bed in living room.

More families entertained guests in guest rooms than entertained them in bedrooms of family members, but more family members were affected by this doubling up than benefitted by having guest bedrooms. It was the large family who must double up when there were guests. The small family much more often had a guest room. In fact, a few of them had more than one guest bedroom.

Families in this study, regardless of size or socioeconomic status had had some company that stayed overnight during the year preceding the interview. The report of the homemakers as to the number of times they had guests who stayed overnight in the 12-month period is summarized below:

Number of times guests stayed overnight	Per cent of families
None	2
1-4	26
5-9	10
10-19	31
20-29	4
30 or more	27

Table 3. Percentage of families with specified rooms using them as a place for members of family and for guests to sleep.

Room	Family members only	Guests only	Both family members & guests
	Per cent	Per cent	Per cent
Bedroom No. I	99	1	14
Bedroom No. II	70	30	57
Bedroom No. III	72	28	56
Bedroom No. IV and over	52	48	52
Porch (side and back)	3	0	1
Hall	14	0	0
Living room	7	22	2
Dining room	1	1	0
Kitchen	1	0	1

A number of the families who had overnight guests as frequently as thirty times a year were those with grown children living away from home who came for weekend visits. The longest visit any guest had made ranged from one night in 13 per cent of the 157 homes that had such guests, to more than two weeks in 18 per cent of them. The median number of nights reported as the longest time stayed was four.

Overnight guests came in groups of two or more much more often than they came singly. The usual number to stay at one time as reported by the 157 families who had such guests was:

Usual number of overnight guests	Per cent of families
One	15
Two	41
Three	26
Four or more	18

Desires of homemakers regarding space for sleeping and resting. If desires of homemakers are followed, a guest room would be included at both the adequate and minimum levels of planning. Half of the 161 homemakers interviewed reported that their overnight guests slept in a guest room, but 80 per cent reported that the guest room was the place they wanted their guests to sleep.

Too few women mentioned wanting a place in addition to that provided in bedrooms or the living room for sleeping or lying down during the day to warrant provision of space for a bed, couch, or cot in other areas.

Washing Up and Baths

The most frequent use made of the back porch mentioned by homemakers interviewed was "washing up." Farm work is dirty work and for this reason there was on many back porches a table with a bucket full of water, a dipper and a wash basin, for the men and boys to wash before coming into the house. But this practice was not followed in every home. In many, "washing up" was done in the kitchen Homemakers tolerated but did not approve of "washing up" in the kitchen.

When asked where they would prefer to have the men "wash up" in a house without a bathroom, 91 per cent of the women replied, "on the back porch." To the question where they would prefer men "wash up" in a house with a bathroom, 40 per cent of the women named the back porch or another place outside the house, but most of these women were without bathrooms. Those with baths almost invariably said "bathroom" when asked this question. Due to the nature of the soil in this Lower Coastal Area, men and boys doing farm work bring in less dirt than in certain other areas. It may be that in another area of the State where the soil is of a more clinging type that homemakers with bathrooms would want another place for the men and boys to "wash up."

"For baths" was not one of the uses of rooms listed on the schedule. (Only 15 per cent of the families had running water with bath tub or shower). So important was this activity, however, that information concerning where baths were taken was reported and recorded on most of the schedules. Bedrooms (often the parents' bedroom) and the kitchen were the places most frequently mentioned. Bedrooms were mentioned somewhat more often than the kitchen. Bathing in the kitchen is no doubt related to the fact that water to take the bath is often heated on the kitchen range and taking baths in the kitchen saves carrying hot water. The parents' bedroom and the kitchen are more likely to be heated—an important consideration in winter. The living room and dining room were other rooms mentioned for baths. These rooms were no doubt selected because they were heated regularly.

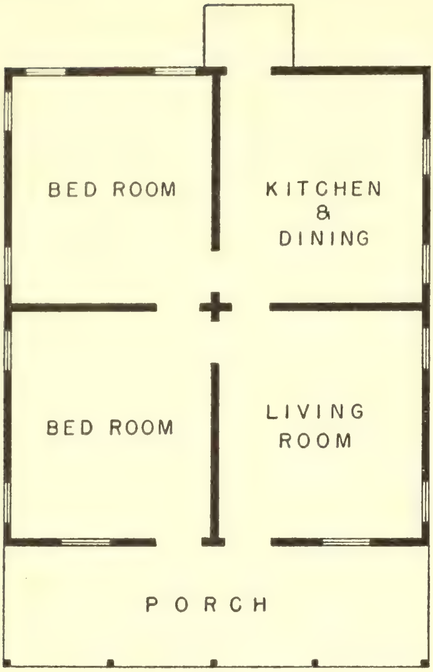
A special room for family baths is desirable not only for privacy but also for centering equipment and supplies needed for the activity and other activities related to health. The homemakers themselves more than any other persons realize this fact. For example, when the women were asked to give the best place to store medical supplies, three-fourths mentioned the bathroom.

It would seem that all new houses for farm families should include a bathroom even though conventional fixtures are not installed at the time of the building. The room can nevertheless be used for baths. Then too, having the room will encourage the family to work towards the goal—a complete bathroom. An important problem for the rural architect is the development of practical suggestions for owners of homes without bathrooms as to best building procedures in providing bathrooms.

Family and Company Sitting and Other Leisure Activities

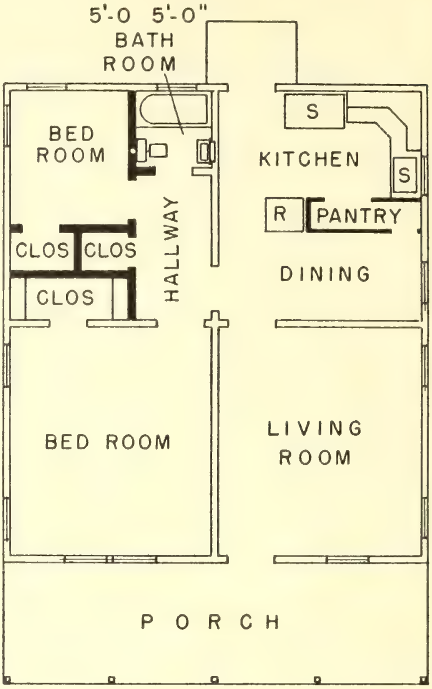
When asked: What rooms does this house have?, about two-thirds of the

IS IT WORTH REMODELING ?


BED ROOM
KITCHEN & DINING
BED ROOM
LIVING ROOM
PORCH

THE PROBLEM

- X NO BATH ROOM
- X NO CLOSETS OR PANTRY
- X INADEQUATE KITCHEN AND DINING AREA
- X POOR TRAFFIC LANES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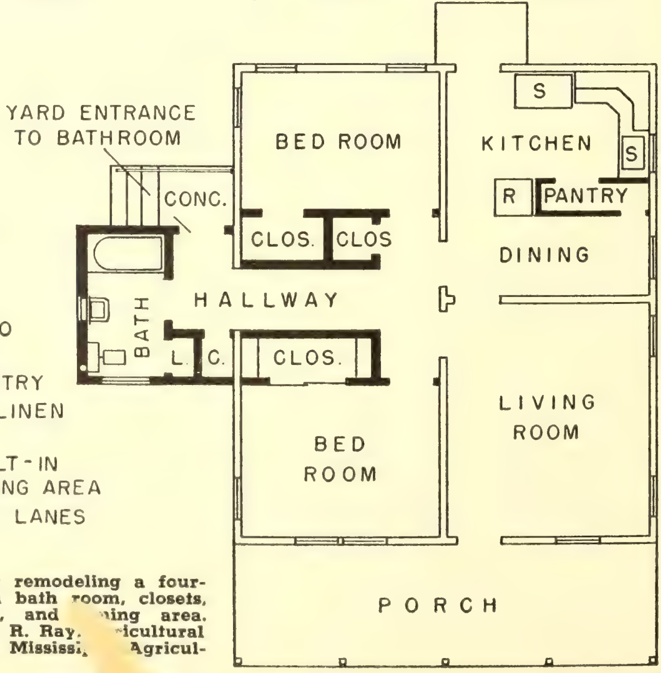
LIVING ROOM
PORCH

REMODELING PLAN NO. 1

- ✓ BATHROOM
- ✓ CLOSET AND PANTRY AREA
- ✓ KITCHEN WITH BUILT-IN CABINETS AND DINING AREA
- ✓ IMPROVED TRAFFIC LANES


YARD ENTRANCE TO BATHROOM
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DINING
HALLWAY
BATH
L. C.
CLOS.
BED ROOM
LIVING ROOM
PORCH

REMODELING PLAN NO. 2

- ✓ YARD ENTRANCE TO BATH ROOM
- ✓ CLOSETS AND PANTRY
- ✓ BATH ROOM WITH LINEN STORAGE
- ✓ KITCHEN WITH BUILT-IN CABINETS AND DINING AREA
- ✓ IMPROVED TRAFFIC LANES

FIGURE 3. Two plans for remodeling a four-room house to include a bath room, closets, pantry, modern kitchen, and dining area. Plans designed by Kermit R. Ray, agricultural engineer, farm building, Mississippi Agricultural Extension Service.

homemakers (62 per cent) listed a living room. That this room was in true sense a living room is indicated by the fact that it was in 91 per cent of the families with such a room, the area which served as the gathering place of the family (table 4). In only 9 per cent of the famlies was the living room a parlor; that is, a place regarded for entertaining company only.

The important inside areas for family and company sitting were the living room and the parents' bedroom (bedroom No. 1). Very few houses had halls, but where there were halls they were used very often for the family living room. The front porch was the outside living room of most families during warm weather. The side porch was an important area for family sitting to those few families having side porches.

Table 4. Percentage of families with specified rooms using them as a family and company living room.

Rooms	Family sitting	Company sitting
Living room	91	100
Bedroom No. I	41	32
Bedroom No. II	7	6
Bedroom No. III	1	3
Dining room	2	2
Kitchen	2	0
Hall	86	21
Back porch	7	0
Front porch	99	95
Side porch	83	17

Homemakers were asked: Would you or wouldn't you want some place besides the living room or porch where there is space for sitting in the evening? This question was asked since it was thought that in families with older children the parents might want some particular area where they could go when the children were entertaining friends. Most women replied, "No." Those who replied, "Yes," and mentioned another area, usually mentioned a bedroom.

From use patterns and preferences expressed by homemakers of this study, it would seem that a living room should be included in a minimum standard for housing. This living room might have to serve the dual purpose of a living room and a family bedroom for a few years. For this reason, it would seem that bedroom No. II rather than bedroom No. I might be used. It is usually the large family (some of whose members are teen-age children) which must combine a family bedroom and living room. The "front" and/or choice bedroom in this case might well be the girls' or the boys' room rather than the room of the parents. It is interesting to note that homemakers reported a few rooms, in which family members slept, as living rooms. One explanation may be that when the two activities were combined they were usually combined in the parents' bedroom and the social aspects of family living were given secondary place. It is important that the living room be located in an area where the social aspects will be regarded as of primary importance.

From table 4 it might seem that these rural families had been untouched by the recent trend of moving the social activities of family living from the front to the back of the house. This is not altogether the case. Thirty-four per cent more of the families expressed a desire for a back porch than had one, and one of the uses which they would make of it was for these social aspects. Also, more homemakers with houses having back porches said they wanted to use the back porch for visiting than used it in this way. At an adequate level of planning, space for family and company visiting would need to be provided on the back porch or in some other place at the back of the house.

Meetings and get-togethers in the home. Homemakers were asked if the family had meetings and get-togethers at home such as club meetings, church groups, parties, family reunions, teenage sessions. Forty-six per cent of the women replied, "Yes." The average number of times families who had such groups had had them during the past year was 1.4. The number of people attending these meetings and get-togethers varied widely. Median attendance for all meetings was 14 persons. It would thus seem that at the adequate level of planning that there should be provision of space in the home for group meetings and get-togethers.

Hobbies . Only 11 per cent of the women reported that family members had hobbies or collections which would have to be given consideration in planning a house.

Serving Family and Company Meals and Refreshments

The evening meal was most frequently the one at which the entire household ate together. At lunch time it was quite usual for part of the family, especially in large households, to eat away from home or for members to eat at different times.

Number of persons serving meals regularly and size of family corresponded closely. Few families had other persons or had hired help eating regularly with them. But all except two families reported that they had extra people at family meals. Some of the women offered the information that these guests were their married children, parents, or other relatives. Of those who had extra people at regular family meals, nearly two-thirds (60 per cent) had them once a week or more often. About one-fifth (21 per cent) had them once in two weeks and 19 per cent less frequently than once in two weeks. One-fourth of the homemakers said they usually had as many as four extra people. One-half reported they usually had as many as three extra people.

"Company dinners" were less important as measured by frequency than the informal and unplanned-for type of entertaining just described. Half the women said they had company meals less frequently than once in two weeks.

The usual number of extra persons at company meals was greater than at family meals. One-fourth of the homemakers reported they generally had at many as six extra people. One-half reported they generally had as many as four.

Locations of dining areas. Shown below are locations of dining areas in the homes of the 161 families and locations for dining which these homemakers would like in a new home:

Locations of dining areas	Per cent of families having	Per cent of families desiring
Dining room only	28	12
Dining room and kitchen	37	45
Kitchen only	28	1
Dining room and breakfast room [3]	3	21
Dining room, kitchen, porch	2	9
Dining room and porch	1	7
Other	1	5

[3] Includes dinettes, breakfast nooks. It is not known exactly what these terms meant to the women who used them.

There were only two per cent of the homemakers who did not express a desire for a dining room. In houses of 29 per cent of the families there was no room reported as a dining room. Of those families having a dining room all used it for some or all company meals and 87 per cent for some or all family meals.

The 158 women who expressed a desire for a dining room said they would usually serve the following meals there in winter and summer:

Meals would serve in dining room	Per cent of families in winter	Per cent of families in summer
Weekday breakfast	18	20
Weekday noon meal	23	35
Weekday evening meal	22	30
Sunday breakfast	29	34
Sunday noon meal	81	87
Sunday evening meal	68	73
Company meals	99	100

In planning at the minimum level where it is not possible to provide for both living room and dining room, it would seem that the dining room might be the room omitted in spite of the expressed overwhelming preference for one. That omission of a dining room in low cost houses will meet general acceptance is indicated by the following facts: (1) Some (29 per cent) of these families do not have dining rooms. (2) When homemakers were asked: If a family of father, mother, two boys and a girl of school age were planning to build a four or five room house, what rooms do you think would be best for them?, few mentioned a dining room in either case. (3) When homemakers were asked how they would use the desired dining room, the majority mentioned Sunday noon, Saturday evening and company meals only. In other words, the dining room would not be an every-day-use reom.

It would thus seem that in low cost houses dining areas might be located in the kitchen and on the back porch. Most families want more than one dining area and a number mentioned desiring an area on the back porch.

Only two homemakers mentioned wanting a dining area in the living room. Only one woman reported her family used the living room for serving meals. Families in this Lower Coastal Area do not dine and do not want to dine in the living room. In fact, the majority do not want to eat in this room. When asked: Where would you want to serve refreshments (a) in winter (b) in summer?, one-third mentioned the living room as a place in winter and a little less than one-fourth in summer. The dining room was the place where the majority wanted to serve refreshments in both winter and summer, though a number mentioned the kitchen in winter, the porch in summer.

As will be noted from figure 4, eight was the median number which homemakers, in families of two through seven members, wanted to seat in the dining room. Families of these sizes made up 94 per cent of the total number who wanted dining rooms. For families of two and three, space for eight would be more than adequate to seat the members of the household and the number of guests usually served at company dinners. For families of five members or more, it would be less adequate than the need as measured in this way.

Sixty-eight per cent of the families ate some or all meals in the kitchen and 58 per cent (almost as many) expressed a desire for the same. More smaller

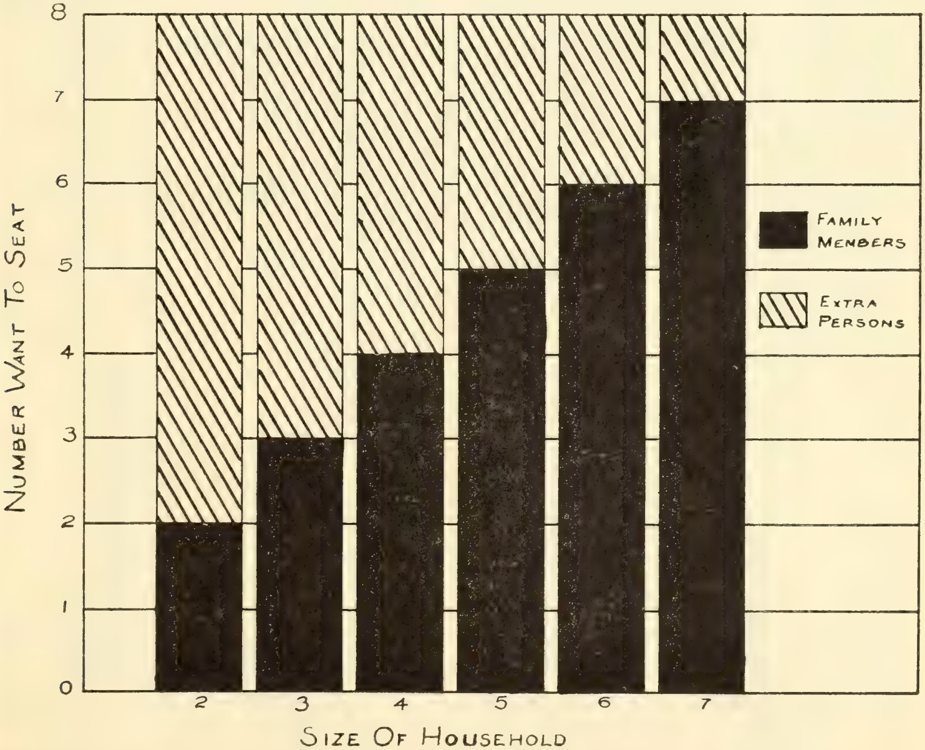

FIGURE 4. Median number of persons for whom seating space is desired in the dining room by size of household.

than larger families wanted to eat in the kitchen. Homemakers in families of two, three, and four members wanted to seat four persons in the kitchen, while most of those in families of seven members or more did not want space for members to dine in the kitchen.

Meal Preparation

Information on the number of people who ordinarily work in the kitchen and on family dietary patterns are important data for developing space requirements for kitchen activities. In this study the homemakers were asked how many persons actually worked in the kitchen when: (1) cooking family meals (2) washing dishes (3) cooking for more than the family—parties, work crews, etc., and (4) canning. In more than two-thirds of the families, everyday cooking and dish-washing were one-person jobs (figure 5). But when canning and fixing food for more than the family, (activities usually carried on by 99 per cent of the families) there was less often just one worker. Provision of each room for two people to work together comfortably in the kitchen would meet the needs at an adequate level of planning.

Since food consumption studies had been made in the State shortly before the housing survey was conducted, data about dietary patterns were limited to baking and buttermaking, two types of food preparation in which planning space requirements to meet family needs is important.

Baking. Two factors enter into space requirements for baking. These are frequency of baking and amount baked at one time. At both a minimum and an adequate level of planning, there should be space sufficient for preparing two baked foods. But at the adequate level of planning about twice as much space would be required for mixing and rolling than at the minimum level since larger batches are made at

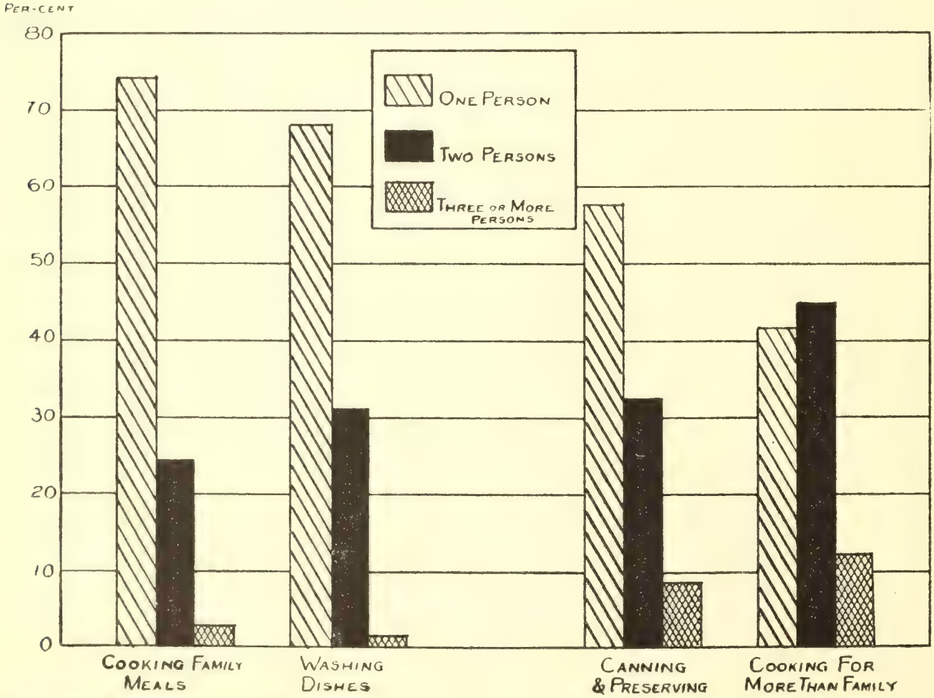

FIGURE 5. Distribution of families by number persons working in kitchen at one time in various activities.

one baking. For example, space for preparation of one dozen biscuits, one pie, two dozen cookies, and one dozen cup cakes and muffins would accommodate 50 per cent of the families, but space for the preparation of two dozen biscuits, two pies, three dozen cookies and two dozen cup cakes and muffins would accommodate 75 per cent of the families.

Buttermaking. Eighty-four per cent of the homemakers reported the making of butter during the month preceding the interview. More than two-thirds of the homemakers having made butter during the past month reported they made it more often than twice a week. Of those 90 women reporting butter made more than eight times during the past month, 28 per cent made it about 12 times, 49 per cent about 15 times (or every other day) and 21 per cent made it every day. Nearly eight out of ten women reported that they had made a pound or less (usually less) the last time they made butter.

Place for food preparation. All families of this study had a room they called the kitchen and homemakers in every family reported that meals were prepared in this room. Another place in which meal preparation took place (principally preparation of vegetables for meals) was on the back porch. About three-fourths of the homemakers with back porches when asked to list uses of the back porch mentioned preparation of vegetables "for table and canning" or "to cook and can." These two areas, the kitchen and back porch were about the only areas ever mentioned for food preparation.

When the homemaker was asked: In a new house would you want porches and if so, how would you use them?, 155 of the 161 women said they would want a back porch (100 had back porches on their houses) and about 90 per cent said they would use this porch to prepare vegetables. Practice and desire of these women in regard to use of the back porch for preparing vegetables was no doubt related to the fact that most of them had gardens and consequently would like some place for removing soil and/or for trimming the vegetables before bringing into the kitchen.

Meat-Cutting and Lardmaking

Ninety-four per cent of the homemakers answered "Yes" to the question: Do you ever have meat in large pieces such as quarters, halves, or whole carcasses to cut up? Forty-three per cent of those replying in the affirmative answered once a year, 31 per cent twice a year, and 26 per cent from 3 to 4 times a year to the question about how often. One or two was the number of carcasses handled at one time.

The median number of carcasses cared for at one time was two for families who cut up meat once or twice a year and one for those who cut it more frequently. All except one of the families who reported cutting up meat reported hogs. Only 16 per cent of those with meat to cut reported beef and one per cent lamb.

The majority of families (89 per cent) made lard. Fifty-seven per cent of the 143 families making lard during the preceding year had made it once, 28 per cent had made it twice and 15 per cent more frequently. Median number pounds of the largest quantity made at one time was 50. About three-fourths of the women reported they stored their lard in metal containers of 25-30 pounds capacity.

Places for meat-cutting. Replies from homemakers to the question about a place for cutting meat show that this is an activity of no particular concern in rural house design. Sixty-six per cent of the women with meat to cut reported that it was done in the yard; 29 per cent reported the activity as being done in the smokehouse. Fifty-two per cent of the women preferred having the activity done in the smokehouse; 15 per cent in the yard.

Food Preservation

The homemakers provided information about: (1) the total quantities of fruits, vegetables and meats canned, jellied, pickled during the year preceding the interview, and (2) the number of quarts or pints of each usually canned in one day (or at one time). They were not asked how many times they canned, but the relation of (1) and (2) shown below indicated roughly the frequency of the activity.

Number of times or number days in which canning was done	Families 2 to 4 members	Families 5 or more members
	Per cent	Per cent
None	1	2
10 and under	22	15
11-20	34	27
21-30	24	27
31-40	13	14
41-50	1	9
51-60	3	3
More than 60	2	3

Number of days in which canning was done shows the importance of this activity, and amount canned in any one day gives a basis for estimating space requirements for the activity.[4] The processing or cooking of the product was usually done in a pressure cooker or water bath. The quantity canned in one day was frequently a multiple of seven quarts, the number of jars the average cooker or water bath canner will hold.

The space needed in terms of quantities canned at one time to accommodate 50 per cent and to accommodate 75 per cent of the families was as follows:

Canned product	Space to accommodate 50% of the families who canned	Space to accommodate 75% of the families who canned
Vegetables, qts.	14	14
Fruits, qts.	14	14
Jelly, preserves, qts.	5	8
Pickle, vegetables, qts.	8	10
Pickle, fruit, qts.	10	12
Meat, qts.	21	28
Poultry, qts.	7	14

Number and kind of jars and pounds of cured meat for which space must be allowed is included in mimeographed material previously mentioned, and is available on request.

Place for food preservation activities. There was quite a difference in the proportion of women who used the kitchen and back porch for preparing foods for canning, freezing, etc., and who said they wanted to use these two areas for that purpose.

Place for preparing food for preservation	Per cent of families using	Per cent of families preferring
Kitchen	32	8
Back porch	46	81
Kitchen and back porch	6	2

The dissatisfied group contained many families without a back porch and some families with a back porch too small or for some other reason not suited to this activity (three-fourths of those with back porches used them for preparing foods for preservation). It is interesting to note that preparation of foods for cooking and canning took place on many unscreened porches, but that homemakers when asked what porches they would want in a new house and whether they would want this porch open, screened, glassed-in, almost invariably replied: "A back screened porch." (One hundred and fifty-five of the women stated they wanted back porches and 90 per cent of these wanted them screened.)

Eighty-seven per cent of the homemakers preferred to process canned food in the kitchen, 92 per cent used their kitchen for this purpose. Places used and preferred for storing canned foods have already been discussed in the section on storage.

Laundering

Replies of the 161 homemakers indicated that laundering was an important household activity. Seventy-nine per cent did all their washing at home and five per cent did most of it. Of those doing all or most of the washing at home, only 8 per cent hired someone to do it.

Homemakers were asked to tell the usual number of (1) sheets and table cloths (2) shirts and house dresses (3) towels (4) children's dresses, suits, overalls (5) work pants, overalls, they had in wash at one time in winter and in summer. Although the list does not include all items to be washed it does make up a large portion of washings done by the average farm family.

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[4] Data on freezing and drying are not presented in this report—since few families carried on these preservation activities—but are available upon request.

Shown below is the space needed in terms of quantities at one time to accommodate 50 per cent and 75 per cent of the families:

Items washed	Space to accommodate 50% of the families	Space to accommodate 75% of the families
Number in winter		
Sheets and tablecloths	5	7
Shirts and house dresses	10	12
Towels	9	12
Children's dresses, suits, overalls	6	12
Work pants, and overalls	4	6
Number in summer		
Sheets and tablecloths	6	8
Shirts and house dresses	11	15
Towels	10	14
Children's dresses, suits, overalls	6	14
Work pants and overalls	4	8

Areas for laundering activities. Fifty-seven per cent of the women reported an outside area used for washing in the summer, 46 per cent in the winter. Another 10 per cent in both seasons reported either a wash house or wash shed.[5] The practice of washing out-of-doors or in a separate building or in a shed was related to the fact that the supply of water was there or near. As has been shown, only 43 per cent of the families had water piped into the house.

When these homemakers were asked the best place to do the washing, the majority of women answered for both seasons (1) a wash house or (2) a utility room. The women were about equally divided between these two places, but a few more mentioned the wash house. Wash houses were more common in the area than utility rooms. Only one in ten women thought the back porch the best place for washing and only one in 100 women thought the kitchen the best place.

Eighty-eight per cent of the 161 homemakers stated they wanted a sheltered place for drying their laundry on stormy days. Forty-one per cent of these chose the back porch, 23 per cent the wash house, 19 per cent the utility room.

Evidently, few of the present houses had special provision for hanging laundry to dry on stormy days. About one-fourth the homemakers to the question: Where do you hang the washing when you can't hang it out in the yard?, replied they didn't do much of their washing or they waited for better weather to wash. Of those naming a place, 57 per cent named the back porch and 19 per cent a bedroom. Some of the women said "all over the house." Practically every room was mentioned, but bedrooms were mentioned most frequently. Three per cent mentioned the wash house.

Areas used for ironing by homemakers were about the same for summer as for winter in spite of the fact that expressions such as "iron where fireplace is" and "iron where it is warm" were written in on some of the schedules. Perhaps the room was heated because it was the place where activities were carried on rather than the activities carried on because the room was heated. In both winter and summer more families ironed in a bedroom and the kitchen than any other area. These rooms were the ones usually heated in winter, but the fact that ironing was done here also in summer is significant. Perhaps ironing was done in the bedroom because the electricity outlet was there or because sadirons were heated there. (Thirty per cent of the families did not own electric irons.)

Even though there was a little difference in place-use-pattern for ironing in winter and summer, there was a difference in place-preference pattern for this activity. Fewer families wanted to iron in the bedroom and kitchen and more on the back porch in summer than in winter. In winter the main places preferred for ironing were bedrooms, utility rooms and kitchens. In summer they were bedrooms, back porches and utility rooms.

An adequate standard for laundry work would seem to be a room for such work, either a utility room in the main part of the house, or in a separate building. With present high building costs, such a standard would not be feasible except for families in the higher socioeconomic group. One possibility for a thickly settled rural industrial area of small farm owners such as included in this study is a community laundry center and/or joint ownership of expensive laundry equipment. This possibility is suggested: (1) by the fact that most of the families who reported only a little washing done at home took their laundry to a "washerteria" (defined by the field supervisor of this survey as a commercial self-help laundry) (2) a large proportion of the homemakers wanted washing done away from main living areas of the house, i. e., wash house, wash shed, basement (3) by the fact that one family in the study had their washing machine in a wash shed in the yard and rented it to their neighbors.

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[5] A wash house was defined by the field supervisor, a resident in the area, as an outbuilding used for laundry which may or may not have running water and may be used for storage also. A wash shed was an open shelter consisting of a roof supported by posts.

This survey did not include an investigation of community services which might be used in lieu of particular high cost housing features for each house. Such possibilities need thorough investigation.

Sewing

Four out of five of the families interviewed reported that they did home sewing. (Seventy-six per cent owned a sewing machine.) The proportion of families who carried on this activity increased slightly with family size and socioeconomic status. It is probable that most of the families who reported no home sewing did mending and repairing of garments but did not consider this kind of sewing important enough to report. Hand mending, such as darning socks and sewing on buttons, however, requires little space.

Those homemakers who stated that sewing was done at home were asked about number of women's and girl's dresses, children's dresses and slips, night gowns, pajamas, shirts, and children's rompers, play clothes they made last year for the family and for others or to sell. A reply to this question would, it was thought, give a basis for deciding whether or not there was enough sewing to warrant a sewing center. Although the list did not include all items made, it does include a large portion of garments for which space must be provided for cutting.

Shown below is the space needed in terms of quantities made during one year for family members to accommodate 50 per cent and 75 per cent of the families:

Number articles made for family members	Space to accommodate 50% of the families	Space to accommodate 75% of the families
Large garments		
Women's dresses (girls over 10 and women)	6	12
Nightwear, shirts, etc.	2	6
Small garments		
Children's dresses, slips (children 10 and under)	0	10
Children's rompers, play clothes	0	0

Seventy-five per cent of the homemakers reported that they had made women's dresses, 57 per cent nightwear and shirts, 30 per cent children's dresses and 25 per cent children's rompers and play suits during the past year. Only six of the 130 women who said they sewed at home had not made any of the garments listed above during the past year.

The proportion of families in which garments for gift or sale to persons outside the family were made was negligible. Only four per cent of the women reported this type of sewing being carried on.

Location of sewing area. Seventy-one per cent of the women who sewed reported they sewed in a bedroom, and 59 per cent thought this was the best place to do sewing. It would seem that a bedroom might serve as sewing center for most families.

Information about the kinds of equipment and supplies for which storage space would be needed is given in the mimeographed material previously referred to.

Business Activities

Information obtained in this study indicated that use of the farm house as a center of business activities was of minor importance for homes of families in the Lower Coastal Area of Mississippi. The minor importance of business activities is undoubtedly related to the fact that families included farmed on a small scale. The majority depended on off-farm activities for most of their livelihood.

SUMMARY

This study concerns information on housing facilities, preferences, and activities of 161 owner-operator farm families in the Lower Coastal Area of Mississippi. Schedules and methods of the Southern Housing Study were used in this study. Data from 90 of the 161 families were also used in the Southern Study. Information on housing facilities, preferences, and activities are of value for designing farm houses that better meet the needs of families in this and similar areas of the State.

Since Mississippi is just now launching an intensive program of industrialization and since about three-fourths of the 161 farm owner-operator families had off-farm work, data from these families should serve as an especially good basis for design of farm dwellings.

Description of Houses

Two-thirds of the houses of the 161 families had been built since World War I. The majority were frame buildings of 5 or 6 rooms; 98 per cent were one story. Sixty-two per cent of these houses had a living room, 71 per cent a dining room, 89 per cent a front porch, 55 per cent a back porch and 4 per cent a side porch. Thirty-five per cent were two-bedroom houses; 47 per cent were three-bedroom houses. Twenty per cent of these farm family dwellings had as many clothes closets as one per bedroom; 29 per cent had pantries. Three-fourths of the houses had electricity, a little less than half had water piped into the house and nearly one-fifth had bathrooms.

Characteristics And Features That These Farm Families Would Like If They Were Building A New House

1. About 85 per cent of those interviewed said they would like the driveway to the house accessible to living as well as work areas so that visitors would enter by front or side door rather than the back door.

2. A sink under the kitchen window would be most acceptable to the majority of the homemakers. Most homemakers voted for a view of the farm from the kitchen window.

3. About 95 per cent would want a one-story house, if building a new house.

4. Two-thirds of the homemakers when asked to select the best room combination in a 4-room house for a family of man, wife, two boys and a girl selected three bedrooms and a kitchen. If they could add another room for this family most of them said they would add a living room.

5. Practically all families would like both back and front porches; 90 per cent of the homemakers expressed a desire for a screened back porch. Only about 60 per cent said they would like the front porch secreened. The back porch was especially wanted (a) to prepare food for canning or cooking (b) to hang work wraps (c) as a place for men and boys to "wash up" (d) for ironing in the summer.

6. Homemakers were not questioned especially about storage, but when asked to name other features they wouldn't build without, mentioned more storage space—usually more clothes closets and/or a pantry.

7. About 85 per cent of the families said they would like one bedroom heated regularly.

8. Two-thirds of those interviewed thought that gas was the best method of heating for their community and voted for the unit heater, but the majority would want one fireplace.

9. Eighty per cent of the homemakers would certainly have a guest room if at all possible.

10. Practically all (98 per cent) of the homemakers stated they would

want a dining room in a new house. The majority would serve in this room the following meals: Sunday noon and evening meals to the family, company meals, and refreshments.

11. Most families stated they would like two dining areas (a dining room and a kitchen and/or dinette).

12. Homemakers were about equally divided between a wash house and a utility room in the house as the best place to do washing.

13. A place for cutting meat is not a consideration in house design. The majority of families want this activity carried on out-of-doors.

14. A bedroom was the location which most wanted for sewing.

Selected Activities That Are Related To Housing Needs Of Farm Families

1. About two-thirds of the families had overnight guests once a month or more. Sleeping space for two guests would provide for the needs of 56 per cent of the families.

2. Family baths were taken in bedrooms and/or the kitchen by the majority of families.

3. Rooms used for family and company sitting and other leisure activities: (a) Living room (about 90 per cent of the living rooms were used both as a place for the family to gather and for company). (b) Parents' bedroom (about 40 per cent of these rooms were used for family sitting, about 30 per cent for entertaining guests). (c) The front porch was the most important place for family and company sitting. There were indications, however, of a trend to move this activity to the back porch, or an area in the back.

4. Dining areas: (a) Sixty per cent of the families had guests drop in for meals once a week or more often. Planned company meals were less important than the unplanned informal type. (b) Space to seat eight in the dining room would accommodate most families. (c) Nearly two-thirds of the families wanted a place for family members to eat in the kitchen. Families of 7 or more members do not usually desire the kitchen as a place for family meals.

5. Food Preparation: (a) There should be space for two people to work in the kitchen. (b) Space for preparing two baked foods would accommodate most families. (c) Churning is done usually more than twice a week but a pound, usually less, of butter is the amount generally handled at one time.

6. Food preservation had been carried on during the year preceding the interview in all except one per cent of the homes. The majority of homemakers reported canning from 11-30 times. When canning fruits and vegetables, two cookers full were more frequently handled.

7. About 85 per cent of the families did all or part of their washing. A little more than half the homemakers reported an outside area used for washing in summer, a little less than half in winter. A wash house and a utility room were the places where more women said they wanted to wash.

8. Ironing was done most frequently in a bedroom and the kitchen, but a number of women wanted a place on the back porch for ironing in summer.

9. Eight-tenths of the homemakers reported home sewing, but very few thought they did enough home sewing to leave the machine open at all times.

10. Business activities were found to be of minor consideration in house design for farm families of this area.